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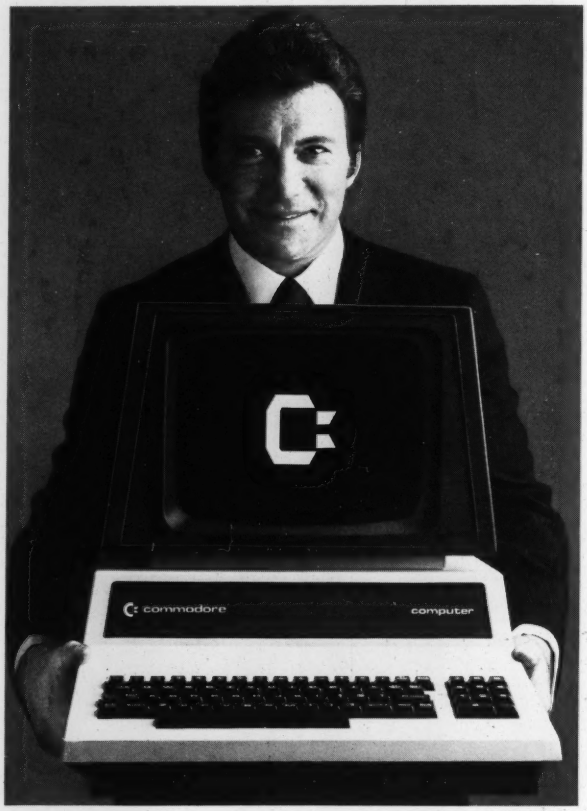

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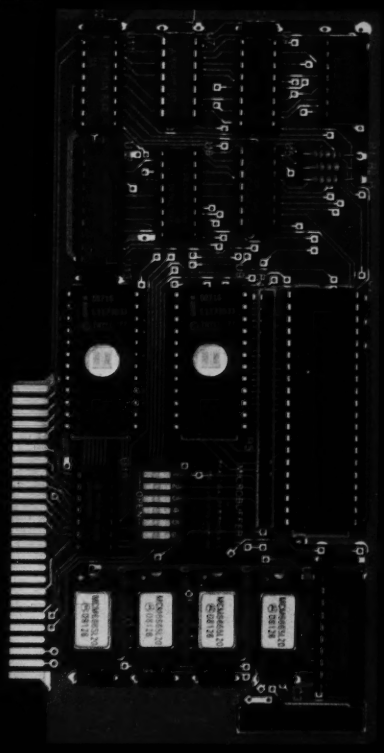

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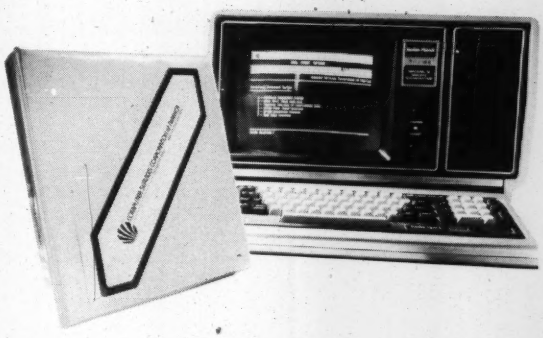

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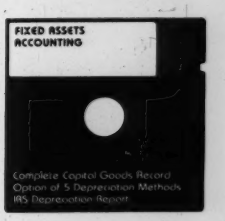

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Hotline Hangup

Dear Editor:

I recently discovered what I think is *bad news* for Apple owners, present and future.

In a field where hardware/software is constantly changing and being updated, one of the best things about Apple was that an owner used to be able to call a hotline number where technical problems could be tackled directly and immediately.

If an individual owner calls one of these numbers today, he gets a recording! He is told to see his dealer, and if it is really an emergency, Apple people will try to return his call within three working days. (Know of any important applications that can wait around for three days?)

The company seems to feel that dealers can henceforth handle service problems, and that this will force us to buy from good dealers.

There are serious flaws in this thinking. No one should be forced to shop around outside of his local area to find a dealer who is technically competent. Further, even if he is technically oriented, how can one dealer be expected to be experienced in all the likely (let alone possible) problems?

And why should a user be forced to fight another layer of people/travel/communications interfacing for service problems? One central service department (or a few regional ones) can always handle servicing better.

As an example, when I bought my first Apple, there was a problem that required an alteration to the mother board—try dropping something like that on your local dealer—the (then) Southern California regional distributor's service department diagnosed the problem over the phone. I took it in and was home again and operating in an afternoon.

"Woe is us" when we have technical problems in the future. Maybe the price tag on the new brands will start looking more attractive—real soon!

Paul Sharp
27173 Sena Ct.
Valencia, CA 91355

Inka-dinka-doo

Dear Editor:

A year ago I bought a Centronics 730 printer, and a generous supply of paper. After a bit of use, it dawned on me that to get legible copies, ribbons were going to cost me more than the paper! This especially irked me, because it seemed that a "worn out" ribbon was in excellent physical shape—just a little short of ink. So I started experimenting with ways of getting the ribbon re-inked.

After some rather messy results, I seem to have hit upon a satisfactory procedure, which I would like to share with your readers. This letter is being printed with a ribbon that has done about 2000 pages already; I leave it to you to advise readers whether it is satisfactorily dark.

The procedure I used should work on all printers physically resembling the Centronics 730, e.g. the 737 and 739, and the Radio Shack printers of same type. Readers may find that a similar approach will work on other printers; however, my technique takes advantage of the fact that the 730 uses a continuous-loop ribbon.

On the left side of the printer (as you face the switches), the ribbon travels down a narrow passage in which its half-twist is supposed to be located. At the front end of this passage it turns very sharply around a post, and quickly reaches the pinch-rollers that pull it along. This latter section of ribbon cuts off a small triangular corner of the chamber.

My approach was to put something in this corner, to re-ink the ribbon as it passes by. What seems to work is a small piece cut out of a regular stamp pad and wrapped in a bit of the cloth that covers the pad. This piece should be big enough to cover the full height of the ribbon, and to press the ribbon slightly out of a straight line path.

It should wedge fairly firmly into the corner, but not press so hard on the ribbon as to seriously impede movement; and it should not be so big that loose ends could protrude into the rollers.

I use regular stamp pad ink; an ounce (for about $1.00) seems enough for several thousand pages. Before any long printout, I usually put a few drops on top of my re-inking pad; this can be repeated in the middle of a very long printout. For satisfactory results you do have to remember to do this regularly, keeping the ribbon well inked.

If you mostly do short printouts, you should ink every few times, and when you finish printing pull the ribbon so it no longer touches the pad. This prevents parts of the ribbon from getting over-inked. With some practice and care, you can get a steady stream of nice dark printouts.

Robin Ault
Concolor Allied Technical Services
45 Dexter Road
Newtonville, MA 02160

Note: The print quality of the letter was excellent—would that all of our submissions looked as good!—EBS

Precisely the Problem

Dear Editor:

I am writing concerning the puzzle page in the August 1981 issue of *Creative Computing*. While this page may be of less importance compared to others, the significance of my revelation seems to be of the utmost importance.

I am concerned specifically with "The Sesquicentennial Puzzle" in which the objective was to find four digit numbers in which the square of the sum of the two digit pairs is equal to the original number.

I followed the puzzle instructions, and attempted to figure it out with my Apple II computer. Well, I think I have found a computer to actually be *wrong*. Of course, I am probably the one who is mistaken, but let me show you my data.

I have included the program I used. Originally, lines 10 and 80 were a for-next loop. However, the computer printed out

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absolutely no answers. So, I attempted to discover the problem. I used only the number 3025, the number used in the puzzle example.

My program does execute the problem correctly as evidenced by the variables' matching numeric values. Both the original number (X) and the resulting square (P) are the same value. However, the computer refuses to admit it. P does equal X, but the computer neither prints X or answers in the affirmative (1) the question whether P=X (i.e.--print P=X).

Furthermore the computer falsely contends that P is actually greater than X. But if P and X both have the value of 3025, how can they not equal each other?

I have only taken a beginning course in basic programming, but I do wish to know the answer to this question.

Thank you for your time, knowledge and cooperation.

Robert Lehrburger
80a Greenacres Ave.
Scarsdale, NY 10583

```
10 X = 3025
20 A = ( INT (X / 1000))
25 B = X - (1000 * A)
30 C = ( INT (B / 100))
35 D = B - (100 * C)
40 E = ( INT (D / 10))
50 F = D - (10 * E)
60 W = (10 * A) + C
62 Z = (10 * E) + F
65 Q = W + Z
67 P = Q ↑ 2
70  IF P = X THEN  PRINT X
80  END
```

```
                  ]PRINT E          ]PRINT X
                  2                 3025

]RUN              ]PRINT F          ]PRINT P+X
(No answer)       5                 6050

]PRINT A          ]PRINT W          ]PRINT P=X
3                 30                0

]PRINT B          ]PRINT Z          ]PRINT P<>X
25                25                1

]PRINT C          ]PRINT Q          ]PRINT P<X
0                 55                0

]PRINT D          ]PRINT P          ]PRINT P>X
25                3025
```

A common problem—when testing a floating point number for equality it is often necessary to test for a narrow range of answers, such as this:

IF A< B+.0001 and A> B-.0001 THEN GOTO 100. This is due to round-off and computation errors and the fact that computers store numbers with more precision then they report them. While the computer would print 3025 for both 3024.99999 and 3025.00001, it would not consider them equal.—GB

We Read You Loud and Clear

Dear Editor:

Does FIS interface with GF? Is DS a peripheral of HPC? When a vehicle is half submerged in salt water does the R in RV refer to "recreational"? Does TriT have something to do with steak, or is it sometimes equipped with BW?

To answer in the cult cant of computer language: no FIS (French interrupted screw) isn't aboard the same vessel with a GF (gallows frame). Nor is a DS (dolphin striker) a peripheral of a HPC (high pressure cylinder). And RV has nothing to do with recreational vehicle. It means, in a submarine, ride the vents. And TriT (triatic stay) is sometimes wrapped with BW (bally wrinkle).

How many thousands of people who would like to have a home computer don't buy one because they're discouraged (and insulted) by the snobbishness of the few experts, each trying to top the other with more unintelligible gibberish?

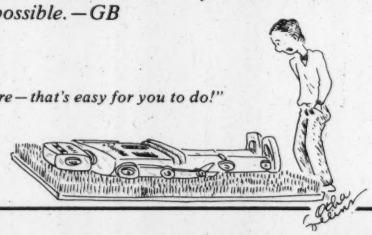
And how many thousands of other prospective customers are dissuaded from buying by folks like me who *did* buy ($5000 worth of Apple) and now tell everybody who'll listen not to spend a dime on computers until the experts learn how to write plain and simple English?

May I suggest that *Creative Computing* begin by:
(1) Writing with words, not symbols?
(2) Devoting a page of each issue to an explanation of the most used-and necessary-symbols?

I'm sure such a method would increase sales to people who now won't buy, and mollify my temper as soon as I get past SYNTAX ERROR.

Robb White
1780 Glen Oaks Drive
Santa Barbara, CA 93108

We agree that technical jargon and symbols limit the readership of articles, and we try to avoid them. Recently my fellow editors demanded that I rewrite my article, "So You Want to Buy a Monitor," (1981 Buyer's Guide*) in order to take the technical discussion out of the article and put it in a sidebar. (A sidebar is a separate comment that runs alongside an article.) I still left an unexplained "NTSC" in the article. I am afraid that dedicating one page to a glossary would not be practical, but we do ask authors to define terms the first time they use them, and avoid abbreviations, symbols, and technical terms whenever possible.—GB*



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Microcomputer Week '82

David H. Ahl, publisher of *Creative Computing*, will speak on "The State of the Art in Educational Software" and present a workshop on "Stimulating Simulations" during Microcomputer Week '82, The Third Annual Conference co-sponsored by Catalyst. The conference will be held March 3-7 at Jersey City State College in Jersey City, New Jersey.

The focus of the five-day event centers upon microcomputers in education at elementary, secondary, and college levels. An additional focus this year will be on acquiring in-depth knowledge and experience at three levels: novice (zero level beginner), advanced (three or more years experience with microcomputers), and intermediate—in more than 20 subject areas.

For more information about the conference call (201) 434-2154 or 547-3094, or write Catalyst Conference, H 112, Jersey City State College, 2039 Kennedy Boulevard, Jersey City, NJ 07305.

Microcomputer Directory

Gutman Library at the Harvard University Graduate School of Education is seeking program descriptions for inclusion in its forthcoming second edition of *Microcomputer Directory: Applications in Educational Settings*, which will be published in the spring of 1982. If you are involved in, or know about a project that utilizes microcomputers for instructional and/or administrative purposes, write to: Microcomputer Directory 2, Gutman Library, Harvard Unversity, Graduate School of Education, Appian Way, Cambridge, MA 02138.

The Library will then send you a standard reporting form.

Corrections

"Boxes, A Structured Spatial Language," which appeared in the November 1981 issue of *Creative Computing*, was co-authored by Bruce Luttrell, 485 Cheney Ave., #6, Oakland, CA 94610. Mr. Luttrell and co-author George Miller are employed by the Bank of America in San Francisco.

In our December 1981 New Products section we mistakenly listed the price of Lifeboat Associates' new accounting system, **The Boss**, at $24.95. The correct price is $2495.

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Microline 82A – 80-column, 120 characters per second .....$ 649.
Tractor Optional .....$ 50.
Microline 83A – 126-column, 120 cps, built-in tractor .....$ 995.
Microline 84 – 126-column, 200 cps, built-in tractor .....$1395.
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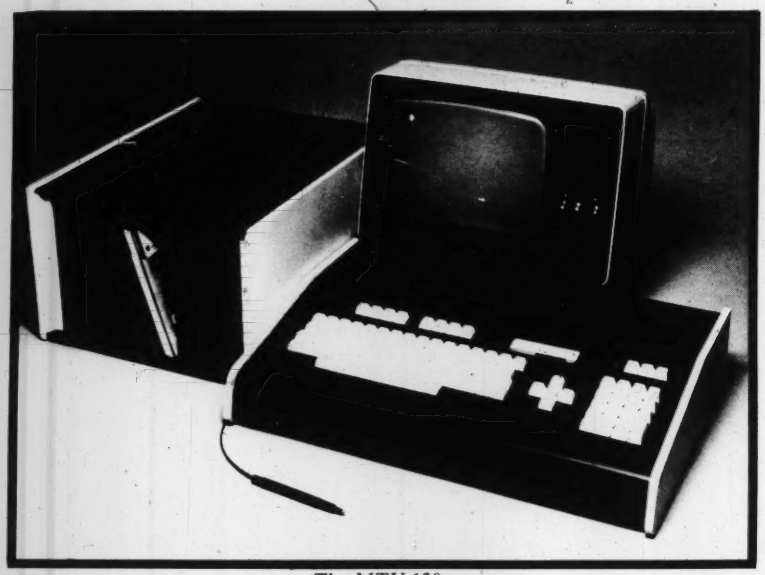
Graphics, Music and More

Carl Strobel



The MTU-130.

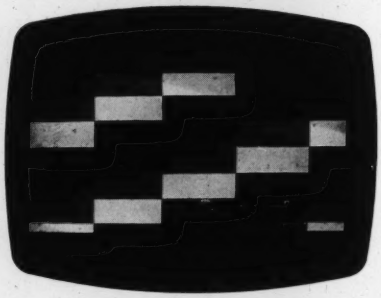
Photography by David Hornick.

When computer professionals get more excited over a new computer than the kids next door, you know the machine has to be impressive.

The computer that is receiving this kind of attention at my house could easily be the most powerful and versatile microcomputer yet offered for personal, professional and small business use. It is the MTU-130, a superb new computer just introduced by Micro Technology Unlimited, a small Raleigh, North Carolina company that up to now has specialized in developing advanced hardware and software enhancements for computers produced by other people.

If the phrase "most powerful and versatile" sound a bit extravagant, add the words "advanced design" and "expansion capacity" and a few other adjectives and take a look at what the MTU-130 offers. It will be a long look because there is a lot to see—memory capacity, quality sound and music, high resolution graphics, a disk operating system that puts many of the bigger systems to shame, Basic and assembly language programming capabilities acclaimed by my professional programmer friends.

Carl Strobel, 1716 Tarleton Way, Crofton, MD 21114.



Two shades of gray, in addition to black and white, can be created in the medium resolution mode. In this mode, the computer provides a 240 x 256 dot matrix for graphics creation.

The computer comes with 80K of system and user RAM and is easily expandable to a directly addressable 256K. If you need more memory, virtually unlimited expansion is possible through a memory bank switching capability.

High resolution graphics has been one of MTU's specialties. The MTU-130 has two graphics levels in addition to its standard 80-column, 25-line alphanumeric display. One level offers the ability to create objects on a 240 x 256 dot matrix in black, white and two shades of gray. The second level provides double that resolution through the addressing of individual pixels on a 480 x 256 pixel screen. The results, as shown in the accompanying photographs, are impressive, indeed.

A high definition light pen feature is standard and provides an easy means of creating graphics on the screen as well as

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Crystal has done its best to become the Porsche of the computer game industry. New scrolling techniques, video disk games, a real-life fantasyland — our mad programmers toil onward with little food or sleep to produce some incredible firsts in the microcomputer world. If you are an unappreciated genius and want to join our staff to help create the world of tomorrow today, give me a call. Our magazine *Crystal Vison* will within the next month have a circulation of 80,000 and we look forward very soon to producing our first full length motion picture. I'd like to thank my friends at Votrax and Axlon for giving us the tools (128K RAM for Atari and a vocal text synthesizer) to truly produce some programming miracles.

★ ★ ★ NEW RELEASES ★ ★ ★

THE CRYPT — One evening you awake at sunset to find yourself in what appears to be an endless cemetery. Although defenseless, you must somehow find your way out or perish from the hideous assaults of flesh-eating zombies, rats, vampires, werewolves, and other repulsive monstrosities. To escape you may have to descend into the catacombs beneath the cemetery. This game is a little different from the others of our series because we use a lot of static graphics to set the mood. It is similar in some respects (without any copying intended) to those of our friends at On-Line who produce excellent static graphic adventures. You must use all your common sense and a great deal of courage to escape from this perilous adventure alive. We have made it so nearly impossible that the first player to do it successfully will receive a $200.00 prize. **$49.95 2 disks**

QUEST FOR POWER by Mark Benioff — An extraordinary game with the adventure and magic of Arthurian legend. Join Galahad as he leaves Camelot in search of the Scroll of Truth. Explore the treacherous depths of the Caves of Somerset, visit the medieval city of Essex. Along the way you will meet powerful wizards and great prophets. The villages of Sunderland and Leeds dot your path. Somewhere in an evil castle called Skenfirth, lurks the devil himself, while the Evil Giant Gogmogo, hungry for human prey, roams the forests. In Fantasyland tradition we include 64 full screens of hires scrolling and some sensational graphic and animation sequences. Well worth the **$39.95 1 disk**; enjoyable to all ages.

★ ★ ★ GALACTIC EXPEDITION ★ ★ ★

The year is 3021, almost 100 years since the expedition to the Sands of Mars has returned. The Starship Herman now rests quietly in the Zikon Museum in New Brisbane. It's nearly 80 years since World War III, the Ames Research Center celebrates its 150th anniversary, and you stand at the unveiling of a truly technological wonder — the first ion-propelled vessel, saucer-shaped Lady Joanne, its viewport of pure diamond, its hull of synthetic emeralds. The Martian glyphs of the Meshim and those of Lemuria have now been deciphered and it appears that a much greater mystery is about to unravel. 7 planes and 7 doors — 7 guardians and 7 candles. 7 strange new worlds await the ultimate adventurer to unlock a timeless secret. The starship may seem strange and unfamiliar to our veteran adventurers, faced with its marvelous new technology; this craft must be flown by constant monitoring of ion stabilizers. During your galactic expedition you are surrounded by the flickering heavens, beset by meteor showers and time-warps. Each unique world holds one of the 7 keys to unlock the Great Mystery. The games all run off the Main Module which also is a game unto itself.

From Earth to Moon — On the Moon's dark side lie entrances to caverns extending to the moon's hollow core which contains a timeless secret. Here live a race of burrowing creatures, who have built vast earthen cities with storehouses full of precious stones. Gravity is extremely critical and you must use all your skills to manually land your craft. This first Master Disk contains the dos needed to run additional scenarios. Its price is **$39.95** and includes 64 screens of Hires graphics.

Mists of Venus — On Venus' ever hot surface are endless jungles and swamps. The air is unbreathable and spacesuits and oxygen must be carried. This world is especially treacherous with all sorts of loathsome creatures and hardly any place dry enough to land your ship. Beneath the green seas our adventurer may find the second key to solving the Mystery. **$29.95** (must have Master Disk to run)

Planet Herman — It is hard to tell where Herman's atmosphere ends and the surface begins. Much of this adventure will have the feeling of a starship submarine. Navigating around Herman is very dangerous but with a computer on board Lady Joanne it may be just possible. This senario costs **$29.95** and needs the Master to run.

The Asteroid Belt — Every play something oids. A combination of the best machine language sub-routines of our new Crystaloids with a fast moving adventure game. Penal colonies, lurking pirates, and some unusual forms of scavenger life exist here. It's difficult to travel in the Asteroid Belt without getting blown up. Perhaps you should find some expert help by rescuing a pilot, who is also a sentenced thief or murderer, from one of the penal colonies. There are places for trading and you may wish to indulge yourself with a visit to the sensual Pleasure Planet. **$29.95** (needs Master Disk)

Uranus - World of Ice — A freezing place with nights of —200° F. Bring along Thermasuits, as well as some Laars with which to battle the Grungik, a 12 foot tall relative of Big Foot, fond of human flesh. Uranus also has a secret inner labyrinth with tropical flora and fauna. However, the King of the Ice Planet, Norion may have his own idea about your trespassing. Without proper clothing, weapons and supplies, your stay here may be very exciting and very short. **$29.95** (needs Master Disk to run)

Jupiter - World of Dwarfs — How would it feel to weigh 300 or so lbs.? A trip to Jupiter should fill you in fast. There is a particularly interesting red spot on Jupiter and a curious set of moons. Picking up some antigravs will help. Landing should really tax your energies. In the Jupiterian atmosphere, you fall fast! Be prepared to use 10 times the normal amount of fuel. Better find the 6th key quickly before your fuel and food are exhausted. **$29.95** (needs Master Disk)

The Crystal Planet - You will have to embark on this final portion of your expedition ignorant of what you may encounter here on this mysterious planet, excepting that the 7th world holds the ultimate key to winning the contest. **$29.95** (needs Master Disk)

The Contest — To the Winner with the highest score, who solves the mystery by November of 1982 will go $5000.00 in cash. Good Luck!

★ ★ ★ ★ ★ ★

GLAMIS CASTLE — According to ancient legend and records this castle is one of the most haunted sites in Great Britain. One Lady Glamis, known to be in league with the devil, liked to send out a destructive demon to harrass the townspeople. She finally was burnt at the stake on Castle Hill, cursing as she died all future generations of the Lyon family. Her demon still seems to haunt that spot, murdering the curious who stray up to Castle Hill after dark. The curse stipulated that each succeeding generation would have at least one child, often female, who would be a vampire. When an heir comes of age, there is a secret ceremony in which the heir, his father, and the steward take crowbars and chip away plaster concealing a hidden chamber, known only to them, that Earl Patie used when he gambled with the devil. Another tradition says that a creature, half-man, half-beast stalks the passages in the walls of Glamis to insure the fulfilling of the curse. The mystery, of course, is to determine the location of this secret chamber. Our game, occupying 2 disks, will have as exact a replica of the castle as possible. It's definitely one of a kind! And we will be offering a $500 prize to the first person daring enough to solve the centuries-old mystery of Glamis Castle. **$49.95 2 disks.**

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CIRCLE 165 ON READER SERVICE CARD

allowing direct user response for such things as menu selection. Programming the light pen is as simple as any other Basic programming, thanks to special commands in the extended Microsoft Basic.

Hal Chamberlin, one of the pioneers in microcomputer music, is vice president for research and development of MTU, so you could expect emphasis on a sophisticated music capability.

The MTU-130 has an 8-bit digital-to-analog converter that not only provides exceptional quality four-voice music but also allows implementation of very life-like human voice and other complex sounds in user programs. This music capability, incidentally, has been used since last fall by Ohio State University in teaching music courses. The computer music has an eight-octave range and programmable envelopes, and each of the four voices has 16 harmonics which are programmable.

The computer music has an eight-octave range and programmable envelopes.

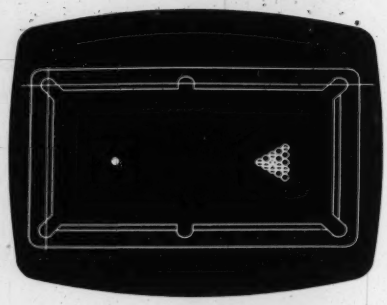
CODOS 2.0

The computer offers what is probably the most advanced disk operating system available for microcomputers. It is superior even to a well-known minicomputer system I've used. Called CODOS 2.0, or Channel-Oriented Disk Operating System, it is a more advanced version of a DOS offered by MTU for the past several years and was written by MTU's software manager, Bruce Carbrey.

CODOS merits a lengthy discussion by itself, and I shall expand on its power and subtleties more fully later. Just a quick word here to note that it offers true I/O device independence and provides a programming flexibility that has to be used to be believed. CODOS also dynamically allocates file space on disk; no need to declare to your DOS in advance how big your files are going to be—even if you know.

CODOS supports up to four double density 8" disk drives, either single or double sided or any mixture of the two types. Disk capacity is 500K bytes for single sided and 1 megabyte for double sided disks. My entire collection of game programs on cassette now resides on one side of one disk with room to spare.

Not insignificantly, the sustained data transfer rate under CODOS is 19.7K bytes per second. MTU claims, and my experience supports it, that CODOS will locate, load and begin execution of a 32K file in three seconds.



The beginning of a game of pool on the MTU-130 which combines high-resolution graphics with sound effects. The two lines which cross at the upper left pocket form the graphics cursor used in this game to specify the point at which the cue ball is aimed.

The MTU-130 is clearly designed for floppy disk operations to take advantage of the speed and power of the system. But an audio cassette port is there for those who want to use tape for input and output. With appropriate software, being developed by MTU, nearly all audio cassette formats in use by microcomputers today can be read and written through the port, making possible tape exchange between the MTU-130 and other computers.

Other I/O ports include an 8-bit parallel and an RS-232 serial port. The RS-232 port has software selectable data transfer rates from 50 to 19,200 baud with programmable data format. It offers another handy way to transfer programs or data from one machine to another, using the Download and Upload utilities in CODOS.

Local netting of the computers, which has significant educational and business applications, is also possible through an internal I/O port. Software, in conjunction with a Network Transceiver Board, will allow data communications at 50K baud.

Finally, for music enthusiasts who want greater sound fidelity than is available from the standard 3" x 5" speaker (which actually provides good quality sound), there is an output for connection to a high fidelity system.

Those ubiquitous folks at Microsoft have written a powerful, extended Basic for the machine. The interpreter is loaded from disk rather than residing in ROM which is the way the minis and mainframes work. It simplifies upgrades and the introduction of more features later on at a cost of about one second's delay while the interpreter loads. Those of us who have lived through Commodore's frequent changes to the PET ROMs can appreciate MTU's good intentions.

The concept of disk-based operating software also makes it easier to implement other languages on the MTU-130.

The Computer

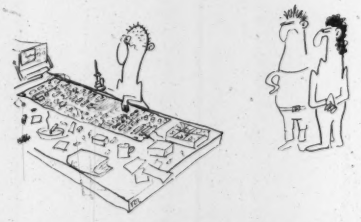
The computer itself is in a nicely styled brown and tan case 22" wide by 14" deep. A 96-key keyboard makes the case wider than that of an Apple, but it is not as high or deep. Upper and lower case letters, numbers and standard symbols are provided, along with special function and control keys. Eight user-definable function keys are at the top of the keyboard where they can easily be correlated to eight "legend" boxes on the monitor—of which more in a moment.

The MTU-130 is a 6502-based machine.

Press a key and you get an audible click through the on-board speaker; "auditory feedback" is probably the elegant name for the feature. As you might have anticipated by now, MTU has made the tone, duration and volume of the click adjustable. Simple modifications to the I/O driver software allow the user a choice—or no click at all. Admittedly, the ability to make keys click to your preference is not a key criterion in judging a computer. But to me it illustrates the thought that went into the design of the MTU-130.

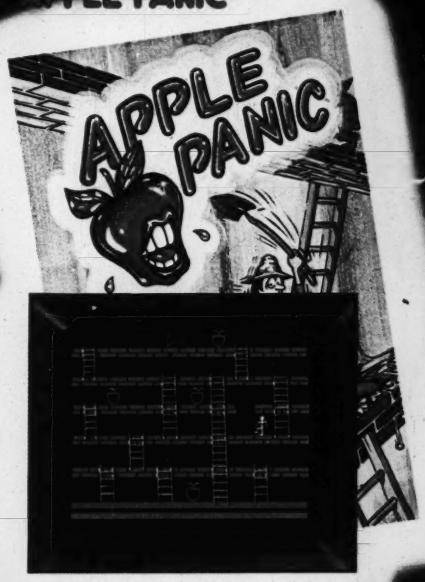
A 12" green-phosphor high resolution monitor sits atop the computer case while the disk drives go on the side of the computer where they are out of the way. Both the monitor and disk drive power supply can be plugged into AC receptacles on the back of the computer case, allowing the MTU-130 power switch to control everything.

The heart of the computer is what MTU has called the Monomeg processor board. It contains the 48K of user RAM, 16K of two-port RAM for the bit-mapped video display which is the basis of the high resolution graphics capability, the I/O and sound generation logic and associated hardware, and a 6502 microprocessor with a 1 Mhz clock rate.



"Yesterday I bought a chip that does all that for 50¢."

APPLE PANIC



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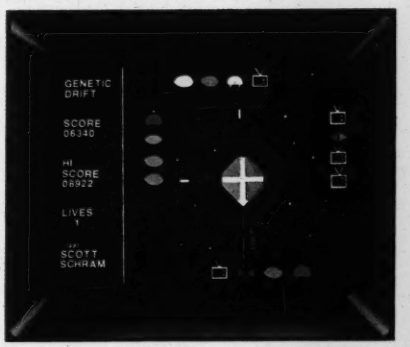
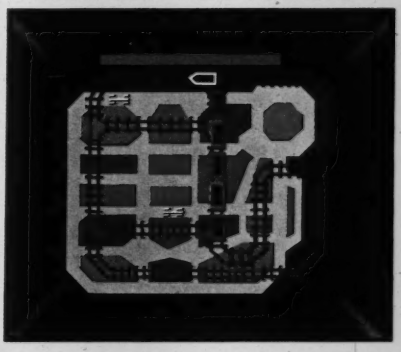


This finger-pounding arcade game requires

TRACK ATTACK



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Yes, the MTU-130 is a 6502-based machine. The company was adamant that this computer, with its highly efficient instruction set and flexible addressing codes, have the speed and power to meet personal computing needs for some time to come. MTU also points to the availability of 6502 machine language programs and programmer expertise in support of their decision.

For those who need some number crunching capability, MTU has a 68000 board in production that will share tasks with the MTU-130. Full handshaking and bidirectional interrupts allow the two processors to communicate. Initially the 68000 will be on a 128K RAM board; this will be upgraded to 512K using 256K RAM chips with the 68000 having straight addressing to all 512K. Up to three boards can be mounted inside the MTU-130.

Memory

The MTU-130 uses dynamic RAM for memory, but the display section keeps onboard RAM refreshed without introducing wait states or other types of system delays.

The exceptional quality of the high-resolution display is achieved by having each pixel addressable in bit-mapped memory. Setting the bit causes the corresponding pixel on the screen to light. The mathematics required to draw objects in high resolution gets a bit complex, but MTU's machine language software routines called by Basic commands make the process rapid and painless for the user.

In the gray scale graphics mode, shades are created combining two horizontally adjacent pixels into a single wider dot. The brighter gray scale dot is set at the same intensity as the white dot in the other mode, creating a relatively dimmer gray and a brighter white.

An 18-bit address bus on the Monomeg board supports the direct addressing of up to 256K of memory. Because the addressing techniques use the address modes of the 6502, in practice the memory is divided into 64K for programs and 64K for data. Further expansion, as mentioned earlier, is possible through use of bank selection registers.

An expansion bus, with sufficient electrical power already available on the MTU-130 as delivered, makes memory expansion a simple matter of inserting memory boards into the existing card files in the case.

Mounted above the Monomeg board is the CODOS disk controller board with 16K of read/write memory, a 256-byte bootstrap loader PROM and the disk controller circuitry.

CODOS is loaded automatically from disk into the memory on the board by the bootstrap PROM in about one second. The critical top 8K of RAM is then write-protected to prevent inadvertent crashing of the system by a user program.

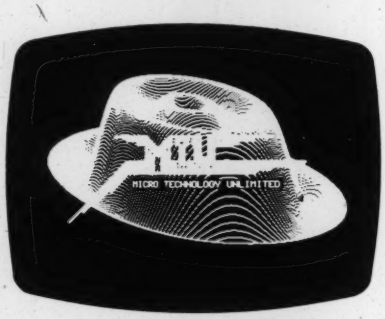
CODOS loads automatically.

Don't judge the power of CODOS by the memory space it occupies. It acts like a much bigger DOS, partly because it is. It is written with 15 overlays which are moved into memory only when needed with no delays in response apparent. The other part of the power story is the fact that CODOS is written in optimized machine language.

CODOS loads automatically. Put a disk in drive 0 or power up with a disk already in the drive and the loading begins.

Once loaded the CODOS monitor assumes control and a series of commands from a job file designated "Startup" are read and executed. The Startup file initially provided with the system does the basic housekeeping needed to get the system running and concludes by asking, in a pleasantly modulated voice (there's that sound capability again) for the date. However, Startup can easily be modified by a user to perform any desired action—such as loading and executing a specific program on disk without involving the user. Totally customized operation is possible.

The automatic booting of CODOS and the possibilities of the Startup file seemed a nice convenience until I talked to Susan Semancik of the Delmarva Computer Club, which has been breaking new ground with its work in computer support for the handicapped. The club was initially interested in the MTU-130 because its fine graphics and animation capabilities lend themselves to work on sign language for the deaf. But Susan saw the automatic loading and customized operation of Startup as a boon for the severely handicapped, such as quadriplegics. A simple device to turn the MTU-130 on, such as a mouth switch, would unlock the full power of the machine.



The MTU-130 displays the company's symbol in high-resolution graphics mode, which allows individual addressing of the 122,880 pixels on the screen.

CODOS Commands

Back to the power of CODOS. It provides for several different types of facilities: there are 35 free format built-in commands, all of which are oriented to system operations, opening and closing drives for example, and manipulation and execution of machine language programs.

The ASSIGN command is at the heart of the channel-oriented DOS and the I/O device independence. What it means is that any file on disk or any I/O device can be simply assigned a channel number and then data can be moved to or from it over that channel. CODOS keeps track of the mundane details.

The system is so simple and flexible that it was actually hard for me to accept at first.

For example, under Basic program control, data can be read in from channel 5, which might be assigned to a data file on disk, and read out to channel 6, assigned to a printer. Reassign channel 6 to a modem, either through the Basic program or by a direct command, rerun the output part of the program and the same data is sent over the phone lines. Once they realize the power this capability provides, newcomers to CODOS are totally converted.

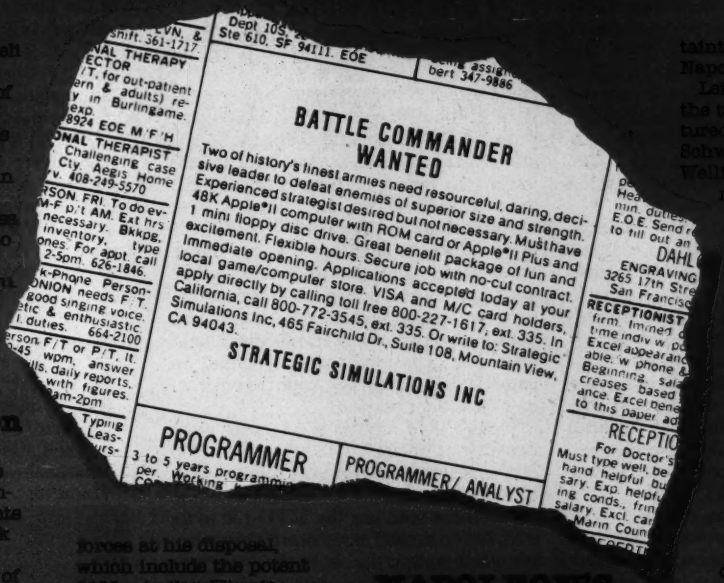
Easy manipulation of machine language files is possible through such commands as GETLOC, display load addresses of files; DUMP, display the contents of memory in both Hex and ASCII; HUNT, search for a string of bytes in memory; and TYPE, display contents of a file.

The convenience and versatility of CODOS is underlined by the way in which the TYPE command can be applied, not only for machine language programs but for a file of any type—Basic program, data or whatever.

The command TYPE XFILE will display the contents of XFILE on the monitor. TYPE XFILE P will send the contents to a line printer. TYPE XFILE YFILE:1 will write a duplicate copy of the file, renamed YFILE, on the disk in drive 1. Another example TYPE 5 ZFILE, will cause input from the device or file assigned to channel 5 to be written on disk as a file named ZFILE.

The system is so simple and flexible that it was actually hard for me to accept at first. I thought I had to be overlooking something.

HELP WANTED


BATTLE COMMANDER WANTED
Two of history's finest armies need resourceful, daring, decisive leader to defeat enemies of superior size and strength. Experienced strategist desired but not necessary. Must have 48K Apple®II computer with ROM card or Apple®II Plus and 1 mini floppy disc drive. Great benefit package of fun and excitement. Flexible hours. Secure job with no-cut contract. Immediate opening. Applications accepted today at your local game/computer store. VISA and M/C card holders, apply directly by calling toll free 800-227-1617, ext. 335. In California, call 800-772-3545, ext. 335. Or write to: Strategic Simulations Inc, 465 Fairchild Dr., Suite 108, Mountain View, CA 94043.
STRATEGIC SIMULATIONS INC
PROGRAMMER
PROGRAMMER/ ANALYST

Man for man, the Israeli army and Napoleon's Grande Armée are two of history's finest fighting forces. SSI's latest games recreate both in meticulous detail — complete in every facet except one: We've left them leaderless. Now we need someone to take the helm of command – someone like you.

SOUTHERN COMMAND™ Job Description

Superb color Hi-Res graphics reproduces the setting for this battalion-level game which recounts the Israeli counterattack to cross the Suez Canal during the October War of 1973 against Egypt.

The 28-by-39 hex-grid map of the Sinai can be viewed as one strategic screen or in twelve

$59.95

separate screens using scrolling.

As the Israeli commander, you have to smash past enemy strongholds, cross the Suez, and establish a bridgehead. In order to accomplish this, your armor, artillery and infantry units — along with your airstrikes — must successfully protect the slow-moving bridging units as they push towards the Canal.

The Egyptian commander's goal is to stop your advance using the forces at his disposal, which include the potent SAM missiles. His air force can be called upon to negate your aerial threat.

To reflect history accurately, Egyptian and Israeli forces differ in efficiency level and strength points. A unique "delayed move" feature allows for ambushes with infantry and artillery.

Thanks to machine-language programming — the computer can rapidly and efficiently calculate, display, and implement combat results to give you a fun and fast-moving game.

You never need to worry about being out of action for lack of a playing partner. The computer can direct the Egyptians and play you at any one of four levels of difficulty. So whether you're a novice or veteran gamer, you're guaranteed a challenging match.

If you feel you have what it takes (and don't wish to relocate in the Middle East), get SOUTHERN COMMAND today and the job is yours!

NAPOLEON'S CAMPAIGNS: 1813 & 1815™ Job Description

$59.95

This advanced-level, board-assisted computer simulation presents a leadership opportunity where experience in strategy gaming really helps. Aside from fully appreciating the painstaking detail and design efforts we've put into the game, a hardcore strategist can more effectively deal with the complexity, frustrations and uncertainties inherent in Napoleonic warfare.

Leipzig and Waterloo are the two campaigns featured. Like Napoleon, Schwarzenberg or Wellington, all your commands are sent to your troops and information about them received via dispatch. Knowledge of troop positions and estimates of enemy strength are only as good as your reconnaissance patrols.

The computer plays the individual corps commanders, whose leadership ratings have been preprogrammed based on historical data. How your orders are carried out depends entirely on the corps commanders, who may follow them to the letter or do so with hesitation. Misinterpretation and even outright disobedience of your directives are also possible.

Night, rain, and terrain all affect troop movement. Intricate rules that deal with the effects of fatigue, corps morale, and leadership on battle outcome serve to mirror history faithfully. They also complicate your decision making and strategy planning.

We know we've painted a pretty tough picture of this job, and we don't expect everyone to apply for it. We're looking for those who can meet the challenge and overcome the obstacles. For these people, we guarantee the same feeling of gratification the Emperor himself often felt when he added up his victory points.

Two-player and solitaire scenarios are provided for both campaigns.

Our Want Ad has all the information you need to land this great job.

SSI

CIRCLE 246 ON READER SERVICE CARD

Software protection against inadvertent deletion of files is provided by LOCK, with UNLOCK making them vulnerable again. RESAVE allows an updated file to replace an older version on the disk. The dynamic file space management of CODOS even allows new files to be larger than the originals; CODOS allocates the additional space as needed. Incidentally, the only maximum limit to file size is that of the disk capacity—500K bytes for single sided and 1 megabyte for double sided.

One feature that long-time disk users have liked is the fact that files do not have to be OPENed or CLOSEd. Only the disk drives need that care.

If the user can't find a CODOS command to his liking, he can create his own. Simply SAVE a machine language program that performs whatever function is needed and the name of the program becomes the CODOS user-defined command. The flexibility of the system is evident everywhere.

CODOS also includes utilities which allow for formatting new disks, copying all or specified files and deleting files. BACKUP is a particularly handy method for duplicating all files on a given disk at high speed.

Two utilities allow users to identify permanently to CODOS the specific configurations of their systems. SYSGENDISK is used to define number of disks, disk drive track-to-track step time and head load time if they are changed from the as-shipped version. SYSGENDEVICE probably gets greater use; with it up to six I/O devices can be added as standard system components, and devices can be deleted or their characteristics modified.

Machine language programmers on the MTU-130 can get mainframe-style support with Supervisor Call instructions, a powerful tool found on many large computers. The SVCs allow programmers to call 30 different subroutines. They are far easier to use and more powerful than a Call Subroutine (JSR in 6502 mnemonics) for several reasons.

The SVCs are address independent, and preserve the value of the machine registers (no saving and then restoring the values when going to a subroutine through an SVC). They are a tremendous aid to program debugging. An error which occurs during the processing of an SVC automatically aborts the program, generates an error message explaining the problem, displays the address of the SVC and records the value of all registers.

Reliability

A few words about the reliability of disk operations with CODOS. Long after many of my friends were boasting of loading speeds with their floppy disk drives I was still wedded to cassette tapes. Their complaints about disk crashes and loss of data, combined with my own experiences on a minicomputer system, led me to choose the slow but reliable magnetic tape.

I am still waiting to report my first crash.

After more than a month of intensive use of CODOS and the Shugart SA801 drives that came with the system, I am still waiting to report my first crash. I have been reasonable, but not fanatic, about environmental controls. The MTU-130 sits in an otherwise unused bedroom where no smoking is allowed and which I dust and vacuum on occasion. But a constant stream of visitors, including my short-haired cat who has penetrated my defenses on at least two occasions and left behind an ample supply of hair, has made the environment less than pristine.

I can't give any data on mean time between crashes or data errors per 1000 disk accesses simply because there haven't been any.

For those who use the MTU-130 in an even less controlled environment than mine, it's worth noting that both the computer case and the disk drive case have positive pressure ventilation—the internal fans suck air in from the outside—which makes filtering a simple task.

Another CODOS feature that supports data recording reliability is an option under the FORMAT command used to write timing information on new blank disks. CODOS will check the disk for bad sections and automatically bypass them in allocating file space.

Extended Basic

I have already mentioned the extended Basic that is standard with the MTU-130. It has several extra commands designed specifically for the computer.

It bears a close resemblance to Commodore Basic, even to the use of the "?" symbol as a shorthand for the PRINT command. It includes PEEK and POKE, and the handy Microsoft string function commands LEFT$, RIGHT$, MID$, CHR$, ASC, VAL, and LEN. The standard arithmetic and trig functions are also included.

Expanded commands include BYE, to exit Basic and reenter the CODOS monitor and TONE, which allows Basic program control over the pitch, waveform and volume of sound generated by the CB2 signal on the parallel output port.

ENTER loads a Basic program in ASCII from a file or device which can then be SAVEd in tokenized MTU Basic. LIST outputs in ASCII format from the machine to a file. These commands make programs more transportable between the MTU and other computers.

OUTCHAN provides I/O independence in Basic by directing output to any previously designated channel as in the CODOS discussion above.

A sample of MTU-130 high-resolution graphics. The boxes, or "legends," at the bottom of the screen give the names of routines which can be called by pressing the corresponding user-defined function key.

The name of a popular computer magazine is written on the screen using the light pen capability. The screen was first made all white and the light pen used to turn off pixels, creating a pattern in black. Reversing the video produced the image shown here.

I mentioned the eight function keys at the top of the MTU-130 keyboard and their relation to the "legend" boxes on the monitor screen. These boxes can display menu information or any other data that a user might have to choose among for input.

One simple example of their utility and the Basic commands that support them was in a simple program using the light pen in creating logic circuits. The LEGEND command, followed by the appropriate labels, printed the names of the logic gates in the "legend" boxes on the screen. By pressing the function key under the appropriate box, I selected the gate to display on the screen where the light pen was pointed.

KEY is used in an ON KEY GOTO ... or ON KEY GOSUB ... command where the KEY value ranges from 1 to 8.

The LIB command adds additional power to the Basic by linking in a designated library of additional specialized Basic

INTRODUCING MTU-BASIC

MICROSOFT BASIC + USER ORIENTED ENHANCEMENTS = MTU-BASIC

CAN YOU

- Save and load BASIC programs in either memory image or ASCII format?
- Input COMMANDS and data to BASIC from a disk file as well as from the keyboard, i.e. drive BASIC from an ASCII "job" file on disk?
- Execute ANY Disk Operating System command from a BASIC program?
- Redefine the effect of keyboard function keys and display legends on the CRT to indicate their present function?
- Use a lightpen to input actual X, Y coordinates on a 480 x 256 pixel array in 1/60 second?
- Obtain very precise coordinate input using a moveable crosshair positioned by the cursor keys?
- Plot high resolution images using screen coordinates or floating point coordinates with the necessary transformations and image clipping accomplished automatically?
- Easily extend BASIC's command set with your own application oriented machine language routine library (up to 8 at once)?

MTU-BASIC CAN DO all of the above yet is based on the industry standard, Microsoft BASIC. If you are missing even one of the above functions, you should find out how an MTU-130 computer can make your association with BASIC a lot more pleasant and better suited to your special needs.

The MTU-130 also comes with other standard features that most computers offer only as options at extra cost — such things as 19.6K Bytes/sec sustained disk data transfer rate, digitized speech playback, 4 voice music synthesis, 480 x 256 bit mapped CRT screen display, fiber optic lightpen, RS-232 port, two parallel ports, hardware for cassette input and output, interface for local network, 80K RAM, 18 bit address bus, 8 bit audio DAC with 1 watt amplifier and a 3″ x 5″ speaker.

Shouldn't you be using MTU-BASIC on an MTU-130 Computer?

MTU
Micro Technology Unlimited
P.O. Box 12106
2806 Hillsborough St.
Raleigh, NC USA 27605
(919) 833-1458

EXAMPLES FROM MTU-BASIC

ENTER "TRANSFER3"
Reads in an ASCII text file as program statements.

SYSTEM "ASSIGN 1 BASICIN"
Redirects input from keyboard to disk file named BASICIN.

LEGEND 1, "First," "Second"
Relegends function keys 1 and 2 to read "First" and "Second".

LTPEN F, X, Y
Sets F = 1 and X, Y to coordinates when lightpen picks a point.

GRIN NW$, X, Y
Displays crosshair and inputs X, Y location of its final position; NW$ contains the exit key.

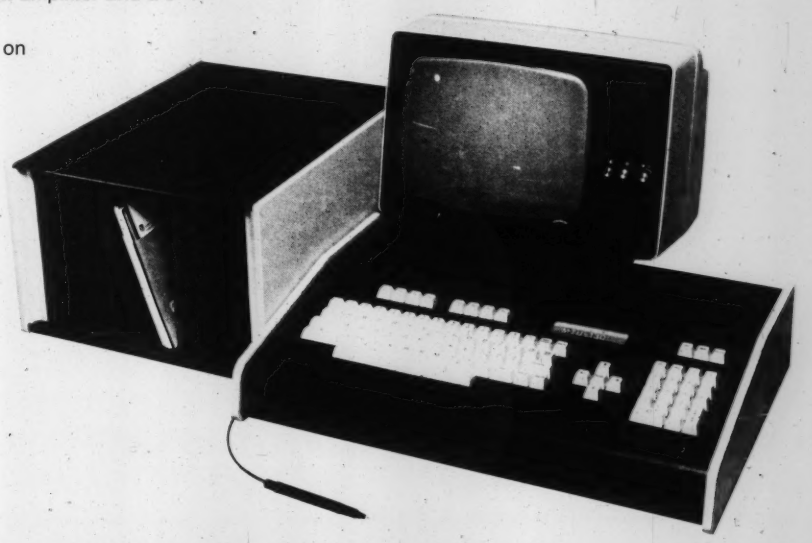
DRAW .0645, 3*Y
Draw a vector from current location of graphic cursor to specified coordinates.

LIB "VGL," "IGL"
Select library extensions to be linked to BASIC.

The base MTU-130-1S system comes with one single-sided double-density 8″ floppy disk, a 12″ green phosphor CRT, and MTU-BASIC for $3995. Three other models priced up to $4995 contain 1 or 2 single or double sided drives for up to 2 Megabytes of storage. 4 Megabyte systems available on request.

We obviously cannot describe fully all of the details of the MTU-130 here. If you wish to know more about this complete desktop computer, call or write for our comprehensive 15 page descriptive literature. International requests include $5.00 U.S.

COME TO MTU — for excellence in microcomputing systems.



CIRCLE 224 ON READER SERVICE CARD

A digitized photograph often demonstrated on the Apple. Shown here in close up, the picture occupies less than half the MTU-130 screen while providing the same detail as the full-screen Apple presentation.

commands. Three such libraries come with the system, the IGL (Integer Graphics Library), VGL (Virtual Graphics Library) and CIL (CODOS Interface Library). Asked why these powerful extensions to MTU Basic weren't included in the Basic itself, MTU had a reasonable answer. Since they are for specialized applications, the decision was made to free up memory space for general use by allowing them to be linked in only if needed.

IGL supports simple graphics by allowing a user to draw lines (solid or dashed according to your specifications) and make use of the light pen.

The light pen command, SLTPEN, is simple to use. It recovers the x and y coordinates of the position of the pen on the screen and sets a flag when this is accomplished. The command checks for the light for 1/60th of a second so a simple loop keeps the pen checking until it sees the light and sets the flag. Use the TONE command and you get an audible signal when the action is completed.

IGL provides the ability to LABEL drawings with textual information. A visible graphics cursor can be moved around the screen to aid in drawing by determining the x and y coordinates of a given point.

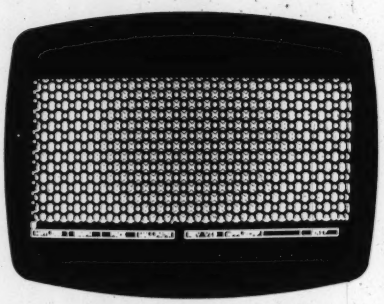
VGL is a more powerful library that includes the IGL commands and adds a few of its own. Most notable is the ability to define a WINDOW and a VIEWPORT. The WINDOW allows graphics display of data using any reference system for measuring x and y coordinates by setting their range. Scaling, in effect, can be done by the program. Any values beyond the range are clipped, as though the lines were actually being viewed through a physical window. VIEWPORT establishes that physical part of the screen where the window will exist.

The third library supplied with the computer, CIL, provides a set of CODOS disk operating commands callable from the Basic program. If the one required isn't there, SYSTEM followed by the CODOS command will make it part of the program.

For ease in machine language programming, MTU-supplied software also includes a two-pass resident assembler which accepts assembly language source programs and outputs source code and listings with error messages and a symbol table and cross reference map. It is a fast and elegant operation according to an experienced programmer who has experimented with it.

MTU-130 Technical Specifications

CPU	MOS 6502, 1 MHz
Memory	80K dynamic RAM (48K user, 16K display, 16K DOS), expandable to 256K direct addressable
Keyboard	96 keys including alphanumeric, calculator display, cursor controls, 8 user-defined keys, Interrupt/Reset
Screen	12" high-resolution green phosphor
Graphics	80-column, 25-line alphanumeric, gray scale graphics on 240 x 256 dot matrix, black and white graphics on 480 x 256 matrix
I/O	Two 8-bit parallel ports, 6522 chip (one internal port); RS-232 serial; cassette interface; video out; audio out
Sound	8-bit analog-to-digital converter, 1 watt amplifier, 3" x 5" speaker, volume control
Light Pen	Plus or minus two pixel resolution, 1/60 second digitizing speed
Language	Extended Basic interpreter loaded from disk, three libraries
DOS	Channel-Oriented Disk Operating System (CODOS 2.0)
Assembler	Two-pass assembler



A simple repetitive pattern shows the capability of the MTU-130 for advanced graphics. This is from the demonstration program provided with the computer.

Summary

One thing rare for a new machine is the total lack of critical comment I have received from other users. Pressed to say something less than laudatory, I could only come up with the complaint that on-screen editing of programs, prior to their storage on disk, is not as good as that of the PET. But few computers are. Lines in programs, for example, cannot be changed by typing over errors and hitting Return. Programs retrieved from memory, as well as text and other files, can be edited very efficiently with a resident Editor program.

In summary, the MTU-130 is a powerful machine. The cost, which no doubt puts it out of reach of the casual or first time buyer is a bargain considering the capabilities of the machine. Prices for the system, which includes the computer, monitor, CODOS, Basic and the libraries, are $3995 with one single sided disk drive, $4195 for a double sided drive, $4495 for two single sided drives, and $4995 for two double sided drives.

No matter how well designed or powerful a computer is, however, there are two key questions which must be considered when evaluating it.

Are there any bugs lurking in the machine that would make the glowing technical specifications meaningless? How much software will there be to support the computer?

Anticipating the first question MTU has carried out a testing program that may well be unique for personal computers. A group of experienced microcomputer owners across the country and in Canada, with backgrounds in such key areas as 6502 assembly language programming, graphics and computer music tested the machine for several months. They provided weekly feedback to MTU engineers. Apart from a few minor or improbable problems

(simultaneously pressing the Mod, Reset and Interrupt keys would cause the system to crash) the computer received outstanding marks.

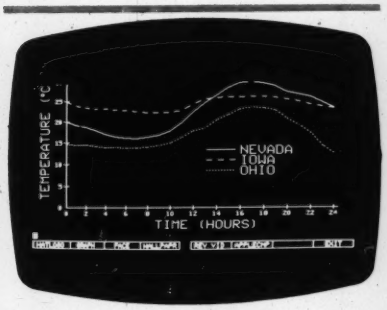
Software

Software development always presents a chicken-and-egg question. No one wants to spend time writing first rate programs unless a large market exists, but the market won't develop unless there is software support for the computer.

Some impressive software, music composition and graphics packages, for example, are already available from MTU's earlier projects. Software development houses are also working on supporting programs, according to David Cox, president of MTU. Among the projects is a compiler for COMAL, a structured programming language that has gained popularity in Europe for business applications.

Another project is rumored to be a Visicalc-like program with expanded applications and more flexible formats.

One feature of the MTU-130 should attract software vendors—a unique software protection feature that allows authorized users to make copies but helps protect software from piracy. MTU would program a unique user number into systems needed for a user, such as high school or university, who planned to purchase software on a use license basis. Only those systems with the proper user number would be able to use the software.



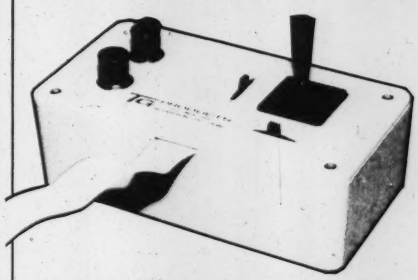
A simple graph drawn with the MTU-130 graphics software enhancement to Basic.

Similarly, a unique vendor number can be assigned to companies buying directly from MTU and selling a customized system to a specific market.

Two user groups have already been formed for the MTU-130, one by MTU itself which plans a quarterly newsletter, which will be free to MTU owners for the first year. The other group is an independent one formed by Jack Brown of Saturn Software Ltd., Delta, BC V4C 5Y9 Canada. Jack is also developing a version of Forth for the machine.

The MTU-130 is an exciting machine which has an exciting future. □

Why would anyone spend $59.95 for a joystick?



Super Joystick

Star Wars. Played with paddles, it's difficult at best and frustrating at worst. But with a joystick it becomes an entirely new experience. It's still challenging. It's also fun. And very addictive.

Have you ever used a drawing program in which one paddle controls the horizontal movement of the "brush" and the other paddle the vertical? It's slow, tedious work. But with a joystick, drawing is an absolute joy.

Exceptional Precision

The Apple high-resolution screen is divided into a matrix of 160 by 280 pixels. To do precise work on this screen, you need a precise device. Most potentiometers used in paddle controls are not quite linear. If you rotate a paddle control at a constant speed, you'll notice that the cursor speeds up slightly at the beginning and end of the paddle rotation.

The Super Joystick has a pure resistive circuit which is absolutely linear within one tenth of one percent. In other words it would give you precise control over an image of 1000 by 1000 pixels, were such resolution available. Thus it is suitable for high precision professional applications as well as educational and hobbyist ones.

Matched to your application

The Super Joystick also has two external trim adjustments, one for each direction. This allows you to perfectly match the unit to your application and computer. Say you want to work in a square area instead of the rectangular screen. Just reduce the horizontal size with the trim control.

How many times have you played Space Invader and had your thumb ache for hours from the repeated button pressing? This won't happen with the Super Joystick. It's two pushbuttons are big. Moreover, they use massive contact surfaces with a life of well over 1,000,000 contacts. A few games of Super Invader using these big buttons will justify the purchase of the Super Joystick.

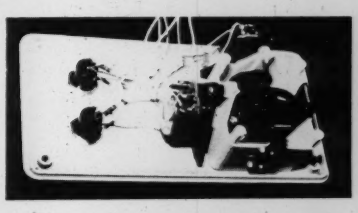
The Super Joystick is self-centering in both directions. That means when you take your hand off it, the control will return to the center. However, if you want it to stay where you leave it, self-centering may be easily disabled.

The Super Joystick plugs right into the paddle control socket and doesn't require an I/O slot.

High-quality construction

The sturdy high-impact molded plastic case of the Super Joystick matches that of the Apple computer. Every component used is the very highest quality available.

We invite your comparison of the Super Joystick with any other unit available. Order it and use it for 30 days. If you're not completely satisfied, return it for a prompt and courteous refund plus your return postage. You can't lose.



By removing two springs, self-centering can be defeated.

The Super Joystick consists of a self-centering, linear joystick, two trim controls, and two pushbuttons mounted in an attractive case. It comes complete with instructions and a 90-day limited warranty. Cost is $59.95.

Order Today

To order the Super Joystick send $59.95 plus $2.00 postage and handling (NJ residents add $3.00 sales tax) to our address below.

Experience the joys of using the world's finest joystick. Order your Super Joystick at no obligation today.

Peripherals Plus

39 East Hanover Ave.
Morris Plains, NJ 07950
Toll-free **800-631-8112**
(In NJ 201-540-0445)

CIRCLE 239 ON READER SERVICE CARD

creative computing software evaluation

Inexpensive Backup for TRS-80 Disks

David A. Hinton

creative computing
SOFTWARE PROFILE

Name: Dumpload
Type: Disk-to-tape backup utility
System: Model I TRS-80, Disk drive
Format: Disk or Tape
Summary: Valuable tool for backing up disk libraries.
Price: $16.95 on tape, $19.95 on disk
Manufacturer:
Complete Computer Services
8188 Heather Dr.
Newburgh, IN 47630

Many utility programs have been written and sold for the Model I TRS-80. Most of these are well-thought-out pieces of software that fill the programmer's needs, and a few of them can even be classified as excellent. Dumpload, created for users of disk-based Model I systems, is one of the newest entries into the utility software marketplace and it, too, deserves to be called "excellent."

Any experienced programmer knows the importance of making backups of the frequently used and valuable disks in his library. Some people, myself included, don't feel safe unless they have backups of their entire library. As the program library grows, having a duplicate set of disks soon becomes a very expensive practice. Some programmers resort to using less costly cassettes to make backup copies of seldom used programs, but this is usually a tedious process and does not work well for all types of software.

David A. Hinton, R.R. 3, Box 44B, Rockport, IN 47635

Any experienced programmer knows the importance of making backups.

Getting Started

Dumpload allows you to make cassette backups of your disk library—but without the usual hassle. It can copy anything and everything (e.g., DOS, data, word processor files, Basic, Fortran, Pascal, assembly code, object code, etc.). The command options allow the user to copy only a certain track, a group of selected tracks or the entire floppy. When making a complete disk backup to cassette, the process is fully automatic even for one-drive users. No more swapping disks in and out of the drive. Just load the desired floppy, load a blank tape, initialize Dumpload and walk away.

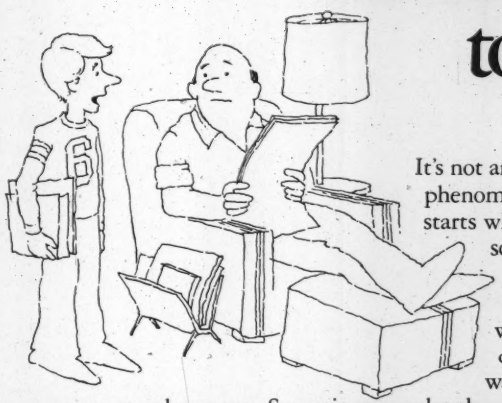
This utility can be purchased on cassette or disk. I ordered the cassette version and received it in about 10 days. The instructions which accompany Dumpload cover the use of both the tape and disk versions. Procedures are included to place the tape version on a disk for easier access or copy the disk version to another disk. Dumpload will work with TRSDOS 2.3 or NEWDOS80 without modification.

A Choice of Speeds

When Dumpload is loaded, it begins by asking if you want to use the standard 500 baud tape speed. What's this, a choice? That's right, the program is capable of backing up a disk to tape at the standard Radio Shack cassette speed of 500 baud or at an optional high speed of about 1800 baud. At 1800 baud, a 40-track disk can be saved on less than 10 minutes of tape.

The written instructions point out that you will have to run at 500 baud if your keyboard contains the Radio Shack XRS-2 cassette modification. If you have this modification, indicated by a keyboard serial number ending with a dash one (-1), don't give up on using the high speed. Another set of instructions included in the Dumpload package gives all the information needed to install a bypass switch which will allow you to enable and disable the XRS-2 modification at will. (This is the same modification required to use B17 sold by ABS Suppliers).

"Dad, can I use the IBM computer tonight?"



It's not an unusual phenomenon. It starts when your son asks to borrow a tie. Or when your daughter wants to use your metal racquet. Sometimes you let them. Often you don't. But when they start asking to use your IBM Personal Computer, it's better to say yes.

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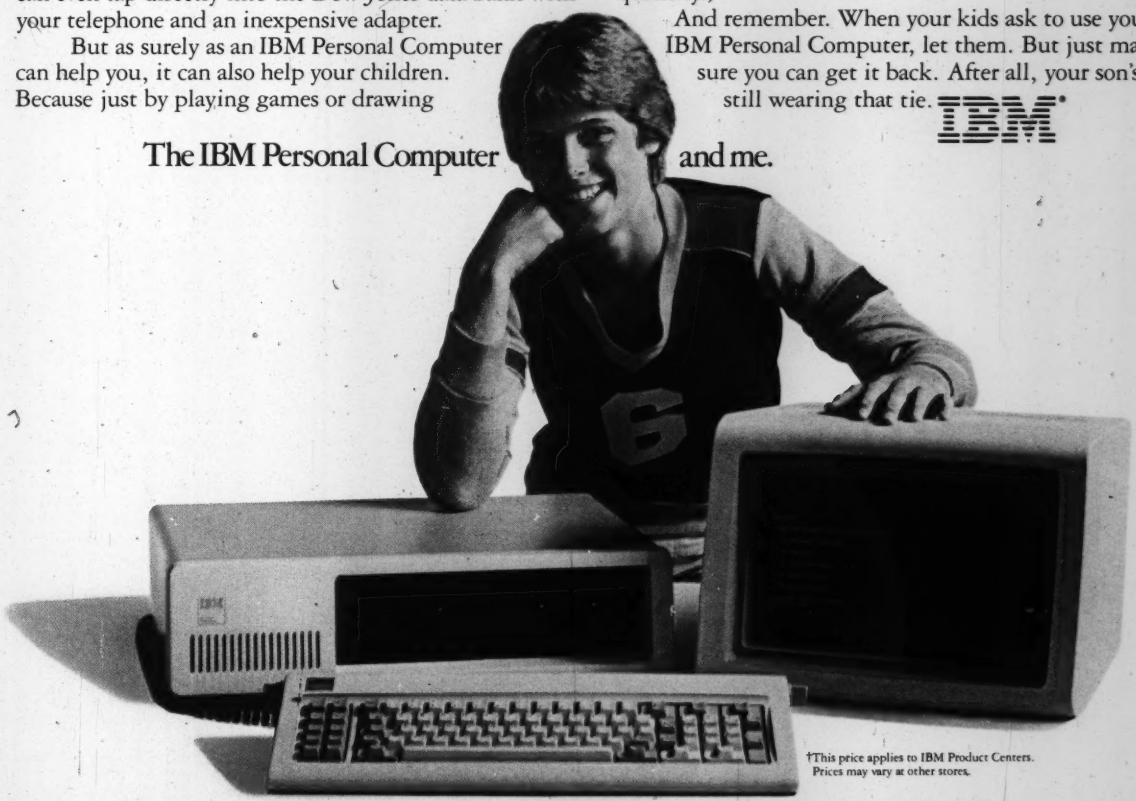

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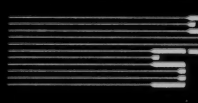

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This game contains graphic and explicit language. Do not order this game if you are offended by such language.

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CIRCLE 218 ON READER SERVICE CARD

Dumpload, continued...

If you prefer not to mount a switch in your keyboard case or you don't have a switch immediately available, the instructions also describe how to disable the XRS-2 circuit temporarily. Neither of these modifications requires any circuit board traces be cut.

Easy to Use

After the tape baud rate question is answered, an introductory message and a menu of three options are displayed on the screen.

Option 1 dumps the disk, which must be in drive 0, to tape. All you have to do is load a blank cassette, set the recorder for record mode and answer the questions displayed on the screen. You are first asked the starting track number.

You may start with any track you desire. Pressing "enter" without giving a value defaults to an answer of 0.

You are then asked, "How many tracks on this diskette?" Pressing "enter" gives a default answer of 35. If your disk contains more than 35 tracks, or you only want to dump a few tracks, you can indicate this by typing "40" or the number of the last track you want to dump.

My article was recovered safe and sound in about one minute, thanks to Dumpload.

Option 2 will restore the Dumpload tape to a disk. All you need to do is load the recorded tape in the cassette recorder, set it for play mode and load any formatted disk in drive 0. The tape contents will then be placed on the disk with each track being restored to its original position without any further action from you. If a checksum error is encountered, the recorder will stop. You can then choose to rewind the tape to the blank area preceding that particular track record and try Option 2 again, restore the track to disk with the checksum error or discontinue the restore attempt.

Option 3 permits you to verify that you have made a good tape. It will read the tape records, looking for checksum errors, but will not write to the disk.

Options 4 and 5, which allow you to exit Dumpload, are mentioned in the written instructions but are not displayed on the screen. Option 4 will return you to DOS Ready, and Option 5 will reboot the system.

How It Works

Dumpload creates a record or series of records on the cassette tape with each record constituting one disk track. The records are separated from each other by a blank area of tape which enables you to position the cassette at the beginning of any desired track record manually. A checksum value is computed for each disk track as it is processed before it is sent to the recorder. This checksum value and the track number become part of the actual record stored on the tape. Therefore, when a track record is being restored from tape, the computer can verify that the tape record is good and where that particular track record is to go on the diskette.

A Personal Experience

I wrote this article using my TRS-80 as a word processor. The article was about half finished, when the power company provided me with a two-second interruption in service.

My first thought was to congratulate myself for having just saved a current copy of my file to floppy. I then rebooted my disk. The drive motor clicked into action but nothing happened. The motor timed-out and stopped. I tried again and got the same results.

That's when I had my second thought: "Oh no, it's gone!" I inserted a different disk, booted, and everything worked perfectly. "Well, that's it. I have lost my article and all the other files on that disk, I thought. But wait, it acts like track zero is glitched and that might be the only problem." Since Dumpload can copy and restore a single track, I figured I might as well give it a try.

I loaded Dumpload, inserted a good disk into the drive, and a blank cassette into the recorder and dumped track 0 to tape. I rewound the tape, inserted the glitched disk into the drive, and loaded track 0 on the disk. I then booted the disk and was back in business again. My article, along with all my other files, was recovered safe and sound in about one minute, thanks to Dumpload.

Conclusion

Dumpload is highly interactive, and, therefore, is easy to use, even for the beginner. Once an option to save or restore a disk is chosen, it is as fully automatic and convenient as making a backup using two floppy drives. I have found it to be a very simple, inexpensive way to protect my large library of disks.

Dumpload is available from Complete Computer Services, 8188 Heather Dr., Newburgh, IN 47630. It is sold on cassette for $16.95 or on disk for $19.95. If you send them a disk containing TRSDOS 2.3 or NEWDOS80, they will install Dumpload on your disk, return it and charge you only $15.95. □

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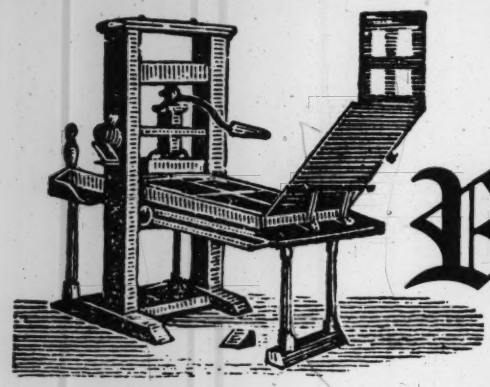

Re: Print

David Lubar

Printers. They haunt me at night, chasing me on tractor rollers, trying to snare me with lassos of ribbon, shouting "Review me!" There are so many new ones. But it isn't all a horror show. A good printer is a thing of beauty, worth using, worth reviewing. Two front runners caught up with me this month. Their stories follow.

Cost Effective

The Olympia 100KRO is a printer to ponder. Doubling as an office typewriter, producing letter-quality printout with a daisy wheel, it costs an unbelievably low $1690. The only tradeoff is speed. At a top speed of 300 baud, with some data required for signals and other information, the printer can do about 16 characters per second at top speed. Add to this the unidirectional nature of the printing and you don't exactly get a racing model. But at that price, who is going to complain?

While someone went on quest for a serial interface card for the Apple, I tried the Olympia as a typewriter. In some subjective way that can't be explained on paper, it just felt right. It is a large unit, with scads of extra features. One that immediately won my heart was an eight-character memory that works with the correction key. With each stroke of this key, an errant letter is removed. Great. A smart repeat key repeats whatever character was last typed. Index and reverse index keys repeat automatically when held, advancing or retreating the paper. The wide carriage with friction feed takes anything fed to it, and a control switch allows for carbon copies. Margins, once set, are remembered for up to 90 hours with the power off. Any changes in settings are reinforced with a beep, letting you know the Olympia has heard you. Taking the Olympia beyond the smart-typewriter class, a serial port in the rear of the machine allows communication with any computer capable of serial communication.

Once an interface card appeared, the real test began. First, the Olympia produced a mixed-case file from Apple Writer. The next test was short program listing. Everything seemed fine until I took a close look at the listing. The greater-than and less-than signs had been replaced with other symbols. An examination of the type wheel confirmed the absence of these characters. Fortunately, a call to Olympia produced the hoped-for answer. An ASCII wheel is available, but it was currently on back order. Although this prevented a test of the ASCII wheel for now, Olympia seems determined to grab a share of the computer market, and the scarcity should be short lived. Beyond this small problem, all was fine (see Figure 1 for print samples). With a California Computer Systems serial interface, the user just plugs in both ends of a serial cable (not supplied), and the printer is ready to run. Some interfaces require a special wiring jumper. Again, Olympia provided the required information, showing evidence of good customer support.

The printer is accompanied by a manual that covers the typewriter aspect, and a few spec sheets on the interface which might bring joy to the hearts of engineers but did little for me. Fortunately, the specs aren't needed unless one wishes to create some sort of special interface or other bizarre project.

Ribbons come in cartridge form, with carbon and fabric being available, and they just snap right in. A separate spool holds the correction ribbon. Type wheels snap in using a special holder. If you need letter-quality printout and can live with a slow print speed, the Olympia 100KRO is definitely worth checking out.

Olympia is backed by a large dealer network, and many stationery stores carry Olympia supplies. Since it existed as a typewriter before the introduction of the interface, the scarcity of supplies that plagues many printers shouldn't be a problem. If you plan to use it for program listings, make sure an ASCII wheel is available from your dealer. If your main application is word processing, it's ready to go as is. Just add a serial cable and an interface if your computer doesn't have one, then let the beauty loose.

The Olympia 100KRO lists for $1690. Their address is Olympia USA, Inc., Box 22, Somerville, NJ 08876.

CIRCLE 252 ON READER SERVICE CARD

```
The Olympia produces letter-quality printout.  It also
functions as a typewriter.  This example was done with
a carbon ribbon and the standard typewheel.
```

Figure 1. A sample of what the Olympia has to offer.

Connect the Dots

Rising from the ashes of the 737, the Centronics 739-1 is a dot matrix printer with some nice features. It takes fanfold, roll, or single sheet paper, prints at up to 100 characters per second, uses a parallel interface, and has switch-selectable character sets for six languages. The baud rate is also switch selectable, and can range from 50 to 19200. We tested it on a TRS-80, but it should work on any system capable of parallel communication.

Let's get the few negative aspects out of the way first. The design of the paper feed is such that fanfold paper, if left unattended, will curl back to the rear as it emerges and re-enter the feed area. This can cause a rather severe jam.

Paper loading requires removal of the top. While this just lifts off, it can be a bit of a nuisance. Also, some desirable printing combinations are not supported. For instance, Centronics does not recommend switching from normal monospaced characters to other characters in the middle of a line. This precludes such possibilities as printing a condensed superscript. Finally, while the printer produces up to 100 characters per second, it prints unidirectionally, thus losing time while the printhead returns to the left margin.

The above complaints are all minor, and are compensated for by nice print quality with descenders, a selection of print sizes, and graphics capability. Basically, three types of print are available: normal (ten characters per inch), condensed (16.7 cpi), and proportional. Vertical spacing is six lines per inch. Each of the three can also be printed in elongated form. Samples of these can be found in Figure 2. The 739 powers up with the normal characters. Other styles are selected through escape codes. A new code is required for each line of elongated characters. Other user controls include underlined text and half line feeds in forward and reverse directions.

While right justification is possible using proportional spacing, it requires some complex programming on the part of the user. From one to six dot spaces can be sent using an escape sequence, but the spacing algorithm must be programmed by the user.

Graphics are produced using codes that control six vertical pins. Once the graphics escape sequence is sent, any command to print CHR$(N), where N is in the range from 32 to 95, will produce one of 64 different vertical dot patterns. Graphics printing, with support of such codes as line feed and carriage return, continues until a new escape sequence is sent. Each line can contain up to 594 dots, producing a maximum row length of eight inches. Through user programming, a good graphics dump can be produced. Even systems without screen graphics can produce paper graphics, though the method is up to the user. With the right software driver, it would even be possible to use the graphics for special character sets. In essence, this would be a software character generator that intercepted each letter and sent the proper series of graphics commands.

In general, it seems that while the Centronics functions perfectly well without any user effort, it should be possible, with a bit of work, to get many extras from the printer. For instance, superscripts could be printed by issuing a half reverse line feed (though, as mentioned above, a condensed superscript cannot be used in a line of normal characters).

All things considered, the Centronics 739 is a worthy printer for graphics, listings, in-house letters, and any other applications that don't require fully formed characters. The printer is priced at $995. Centronics Data Computer Corporation is located in Hudson, NH 03051. □

CIRCLE 253 ON READER SERVICE CARD

```
Normal printout at 10 characters per inch
Proportional normal characters
Elongated normal (monospaced)
These characters are condensed
This is condensed elongated
Here is condensed proportional
```

Figure 2. A selection from the Centronics cast of characters.

Centronics: A Look At the Future

Interview with President John Tincler

David Ahl and Betsy Staples

We know that our readers are interested in printers. In fact, in response to our last reader survey, 59% said that a printer was the next peripheral on their shopping list.

Centronics Data Computer Corp. is one of the largest and most visible manufacturers of printers, selling not only under its own brand name, but also supplying larger computer manufacturers such as Radio Shack and Atari.

Yet, in recent months, the media have carried tales of slipping profits, and last summer, *Creative Computing* received letters from several readers who were disgruntled enough to write us recounting tales of woefully inadequate service on their Centronics printers. We were curious, so we called then newly-installed president John Tincler for some answers.

The Mistakes

Mr. Tincler, formerly executive vice president of operations for Centronics, was named to the presidency of the company in May of 1981. When asked to what he attributed the reported financial losses, he cited "an accumulation of things that have occurred over a period of years, specifically some inventory problems."

Among steps being taken to correct the problem, he named "the recognition that we should have completely phased out the 100, 300 and 500 series printers," and that Centronics's initial offering in the small printer market, the 730, "was being replaced by the 737 and 739."

He hastened to add, however, that reserves have been established to allow the company to continue to supply parts for the discontinued model.

Another area in which Centronics had been losing money was its sales to foreign markets. Because of the sudden increase in the strength of the dollar overseas, many companies in similar positions have experienced losses in translating prices from one currency to another.

"We hope that the inventory problem is behind us and we look to the future. As far as translation losses are concerned, we are in a position to adjust our prices, and we are taking steps to prevent this from continuing," said Mr. Tincler.

The Market

Is the 730 series of printers being received by the market as well as he expected?

Mr. Tincler believes that "Centronics built the market, and has certainly gained a tremendous share of it. There is opportunity there and good market acceptance of the product.

"Unfortunately, the Japanese came in very strongly, and are intent on capturing a large part of the market. They have already made inroads."

How does he see the continuing impact of such Japanese printers as Epson and Oki?

"From all reports, the Japanese product is reliable, and certainly cost-effective. As a company, we are not in a position to compete on price. If the price level in that market is driven down, which seems to be what is happening, we will have to find a more sophisticated user, one who is interested in the functional capacity of the product as well as the price and our ability to support it.

"I think our edge—being able to provide features which we think are important to users over the long haul and at the same time having the total support capabilities to support these products—is much better than the Japanese can ever expect to have."

Support and Service

Since he mentioned support, we asked Mr. Tincler about the service Centronics offers: Is the company prepared to supply the service that an end user requires, or do they expect dealers to provide it?

In response, he cited the company's new Dealer Support Program, designed to enable dealers of Centronics products to provide repair services for the 737 and 739 at their own facilities.

"Centronics built the market."

Under this plan, a dealer may choose either of two options to become an "Authorized Sales and Service Center." Option I allows the dealer to service the printers himself and to perform module assembly exchange by purchasing a complete package which includes all the necessary materials to repair the machines. Centronics then repairs the modules at a fixed rate. The dealer must be certified to participate in this part of the program.

A dealer taking advantage of Option II collects printers from his customers and then contacts Centronics to make the necessary repairs.

Since the announcement of this program, *Creative Computing* has not received any more complaints about Centronics service, so it may be working.

Speaking, again, of support, what about mail order? What does Mr. Tincler recommend for the computer owner in Indiana who buys a printer from a mail order vendor in California and then finds it needs service?

"I think he has several options. He obviously gets a warranty to start with, no matter where he bought the product. Beyond that, since it is a low-priced item, he is obviously not going to expect a service man to come and service the thing. He has a choice of taking it to the nearest Centronics walk-in service location or sending it to that location for repair."

The Future

We asked about the QuietWriter which Centronics had announced earlier and then "let slip."

" 'Slip' may be the wrong word," he replied. "I think we are going to be more conservative in our approach to preannouncing things in the future, because it is simply not to our advantage to do it.

As for the QuietWriter, "there was interest being generated in the product as far back as two years ago, but the product is still in development—and coming along quite well," he added.

"The machine will employ a whole new technology for putting marks on the paper; it will not be a dot matrix device. It will provide fully formed characters and will still be extremely quiet. We think it is going to have multiple capabilities, being able to work in the word processing enviroment, function as a communications device, and, in time, to be an intelligent workstation."

What about pricing? Will it be in the same range as a Diablo, Qume or SpinWriter, or lower? Mr. Tincler thinks "the pricing will be dictated by the market and the applications with which we go."

He thinks that the lower end printers, like the 739, have a future as the answer to the desire of many users to upgrade their hardware. "People will buy an entry level product that may have few capabilities. They buy it to become acclimated, as a tool to help them become familiar with the type of product while they look around for the additional capabilities and features they want.

"Once they understand the product, they know its value and may be willing to pay more for it. That's where we come in."

When asked for a long-range forecast for Centronics, Mr. Tincler said that "in the long run, it is still a strong, healthy company with many assets. It is still the leading supplier of printers, and with the new products that are on the horizon, the company will take off and grow again very soon." □

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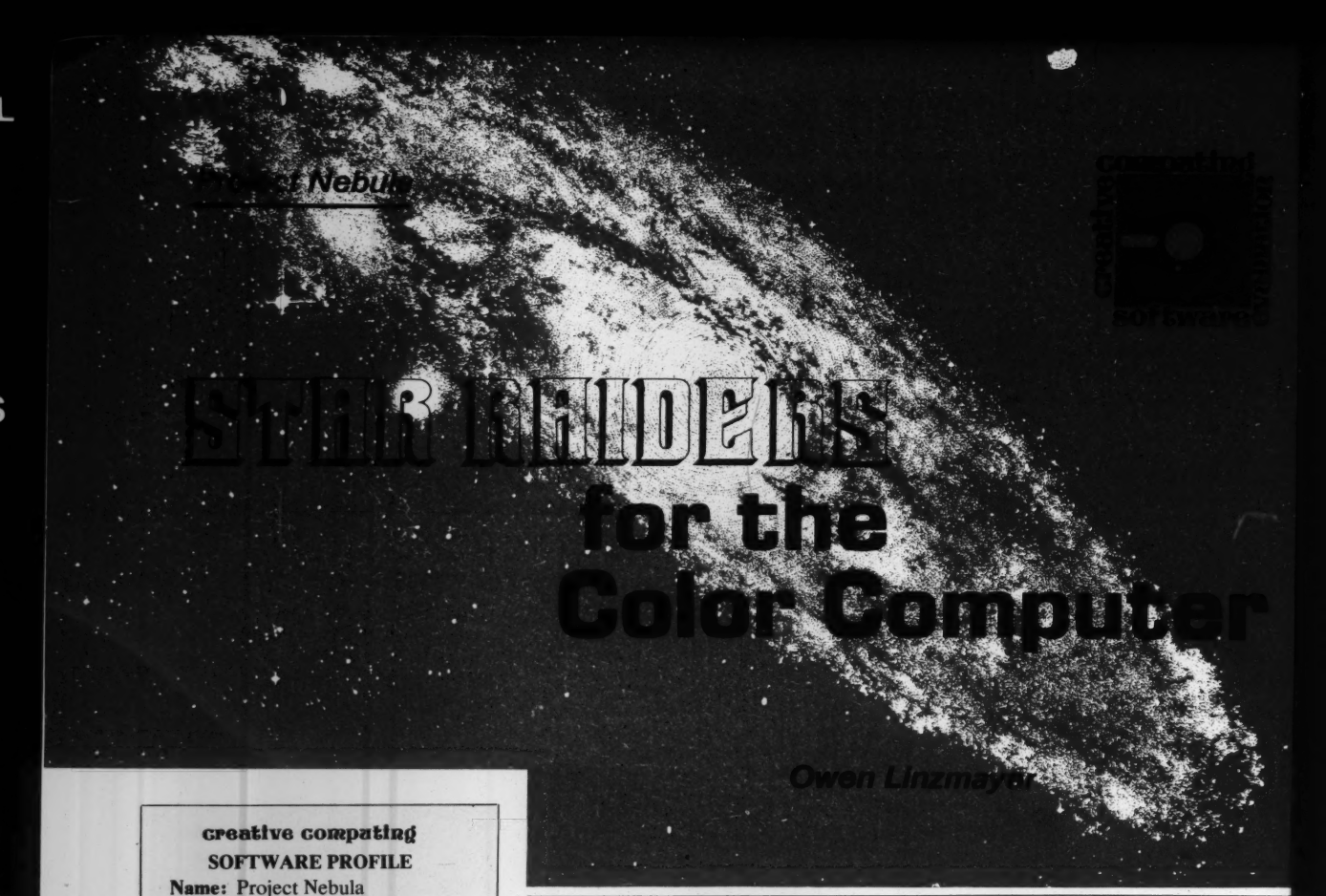

Star Raiders for the Color Computer

Owen Linzmayer

creative computing
SOFTWARE PROFILE

Name: Project Nebula
Type: Strategy/Arcade game
System: TRS-80 Color Computer, joysticks, 4K RAM
Format: Program Rom-Pak
Language: Machine
Summary: Fair Color Computer version of Star Raiders
Price: $39.95 catalog # 26-3063
Manufacturer:
Radio Shack
1300 One Tandy Center
Fort Worth, TX 76102

Project Nebula is a Color Computer version of Atari Star Raiders, a game in which the player controls a lone fighter in space, searching and destroying alien ships in real time.

The object of the game is to defend earth from the evil forces of Zykon. If you are successful in your mission to rid the galaxy of enemy ships, planet Earth is saved. If not, Earth is doomed to become a slave-planet of Lord Scylla.

After inserting the Rom-Pak, you choose among the four game modes. These are Target Shoot, Target Shoot with speed, Star Commander and Advanced Star Commander.

The first two modes are exactly what their names imply: target shoots. They are helpful for practice, to become familiar with your ship's controls and how the enemy fighters act.

Star Commander mode offers a complex mission in which you are aided with a long-range sensor and hyperspace engines to propel your ship into other sectors. The long-range sensor displays the 45 sectors of your galaxy in a lo-res 9 x 5 matrix.

Each sector may contain either a friendly space station, used for refueling and repairing damage, or up to four enemy ships. The only difference between the two Star Commander modes is that in the Advanced one your ship may be damaged. There are ten difficulty levels for each game mode.

The game screen is divided into two displays. The upper portion is a hi-res yellow-on-red graphics display of a cockpit view. It is through this window that you see the stars drift by and enemy fighters swoop in for the kill.

The lower third of the screen is your instrument panel. Located on this control console are two short-range sensors; one frontal, the other rear. These two grids help in determining the location of other objects in the sector relative to your ship. Your fuel gauge is located between the two sensors. Being shot, entering hyperspace and firing your lasers all use up fuel and when the gas is gone, you lose. Directly above the fuel gauge is some sort of scanning device which does nothing but slow down the computer clock speed.

You control your fighters by steering with the right joystick. The ship responds to the joystick like an old plane with a control stick. You can shoot by pressing either joystick button. If you have chosen a mode in which you can control speed, the left joystick acts as a throttle. This is confusing as well as awkward, and play would be much easier if speed were controlled on the keyboard.

Project Nebula has strong points as well as weak areas. On the positive side are the life-like actions of the enemy ships. As the distance between you and the enemy rapidly decreases they become larger and more detailed. Unlike other space games, the attackers move around, trying to evade your shots while attempting to cripple your ship with devastating rocket blasts. Another plus for this program are the variations of game modes and skill levels which make it a hard game to master.

Among the flaws which detract from the general appeal of the game are the obnoxious "sound effects." The static that crackles from the TV speaker is annoying and distracting. Fortunately this problem is easily remedied by turning down the volume control on the set.

The only other major complaint concerns the documentation, which leaves something to be desired. The instructions are extremely brief, and so vague are the docking instructions that I have yet to do so successfully.

On the whole, Project Nebula is an adequate program. The game is good—not great—and has a reasonable amount of entertainment value. Before plunking down the money for the Rom-Pak, ask your Radio Shack dealer for a demonstration to see if the game is right for you. □

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The book will take you through everything programmers learn. Its easy to understand and the large type makes it easy to read. You'll find out how to put together a flowchart, and how to get your computer to do what you want it to do. There's a lot to learn, but **Computers For Kids** has 12 chapters full of information. You'll even learn how to write your own games and draw pictures that move.

Just so the folks and your teachers won't feel left out, there's a special section for them. It gives detailed lesson ideas and tells them how to fix a lot of the small problems that might pop up. Hey, this book is just right for you. But you don't have to take my word on that. Just listen to what these top educators have to say about it:

Donald T. Piele, Professor of Mathematics at the University of Wisconsin-Parkside says, "**Computers For Kids** is the best material available for introducing students to their new computer. It is a perfect tool for teachers who are learning about computers and programming *with* their students. Highly recommended."

Robert Taylor, Director of the Program in Computing and Education at Teachers College, Columbia University states, "it's a good idea to have a book *for chidren*."

Not bad, huh? Okay, you can let the adults back in the room. Don't forget to tell them **Computers For Kids** by Sally Greenwood Larsen cost only $3.95. And tell them you might share it with them, if they're good. Specify edition on your order: TRS-80 (12H); Apple (12G); Atari (12J).

Your local computer shop should carry **Computers For Kids**. If they don't ask them to get it or order by mail. Send $3.95 payment plus $2.00 for one, $3.00 for two or more for shipping and handling to Creative Computing Press, P.O. Box 789-M, Morristown, NJ 07960.

creative computing press

The Axiom EX-850 Video Printer

Silk Screen

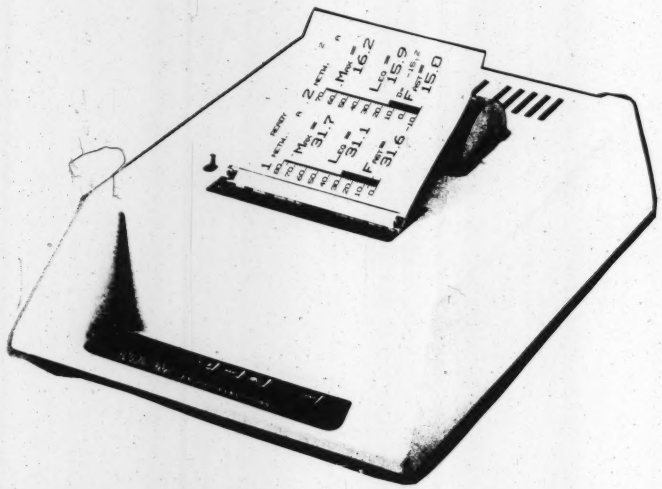
David Lubar

In the last few months, many articles in *Creative* have been graced with an abundance of computer screen pictures. While we've always used screen illustrations when appropriate, the number has increased in the last several issues. Is it a change in format? Is it an urge for art? None of the above. The truth must finally come out. We've got a new toy and we can't stop playing with it. The Axiom EX-850 VideoPrinter is an answer to many prayers.

If you've ever waited for a dot-matrix screen dump, or tried to get a good reproduction of a text page, you know what I mean. In contrast, the Axiom produces an image from the video signal generated by a computer. The magic of this is that whatever goes to the screen can be put on paper, as long as the image can be frozen for a few seconds. Any text face, any graphics, any image whatsoever can be put on paper. The only limitation is that the image will be in black and white. This can cause a slight problem when reproducing color graphics since certain background colors that look fine on a monitor may appear grainy when the pixel configuration is reduced to black and white.

Double-width picture of the Apple Hi-res screen.

To interface with computers, the Axiom contains two input ports. There is a BNC connector for composite video (most home computers produce this sort of signal), and a DIN socket for separate video and sync signals. You first have to make or buy a cable to match the signal and connectors of your computer. In the case of the BNC composite video connection, making a cable is fairly simple. If you need the DIN interface, the wiring is more complex, though it is thoroughly explained in the manual. (Axiom currently sells cables for the Apple, PET and TRS-80.)



The Axiom EX-850 VideoPrinter.

Since computers tend to vary in the quality of the signals they send, a series of adjustments is necessary to get the ideal image. This is accomplished with a combination of dip switches and trimmers. The dip switches allow for a selection of the number of raster scan lines. This can range from 508 to 988, making the Axiom fluent in both American and European systems. Other dip switches allow the user to select a starting point for the printout, thus blanking out raster lines above a certain point. The factory settings on the Axiom worked well on the computers we used.

The three trimmers control horizontal hold, slice level, and video gain. These will have to be adjusted for any specific system. Fortunately, the trimmers can be adjusted while a printout is being produced, thus allowing a real-time check for the correct setting.

Once the settings have been selected, the Axiom is ready to go. It takes aluminized roll paper, available from Axiom and also from a variety of supply distributors. For some reason, the process of printing on this paper produces an odor of chlorine, reminiscent of the YMCA the day after they fill the pool, but you get used to it.

The front panel has four switches. The print switch, as the name suggests, starts the printout process. A paper feed steps the paper forward a line at a time. The reverse switch produces a negative of the screen image. This is useful since a set pixel is white on a monitor, but black when printed out (while this may seem strange, it does make sense: a monitor displays a set pixel by turning on a white dot on a black screen; a printer displays the same pixel by making a black mark on white paper). The fourth switch selects normal or double resolution. In double resolution, twice the number of horizontal points are printed, doubling the width of the printout. A normal printout takes just over thirteen seconds, a double-width picture takes 27 seconds.

So far, we've used the Axiom with the Apple and Atari. It worked well in both cases, though some background colors did produce the patterned effect mentioned above. If you need screen images with any regularity, and have no qualms about aluminized paper, the Axiom EX-850 VideoPrinter might be the answer.

The EX-850 VideoPrinter costs $1595. Axiom is located at 1014 Griswold Ave., San Fernando, CA 91340.

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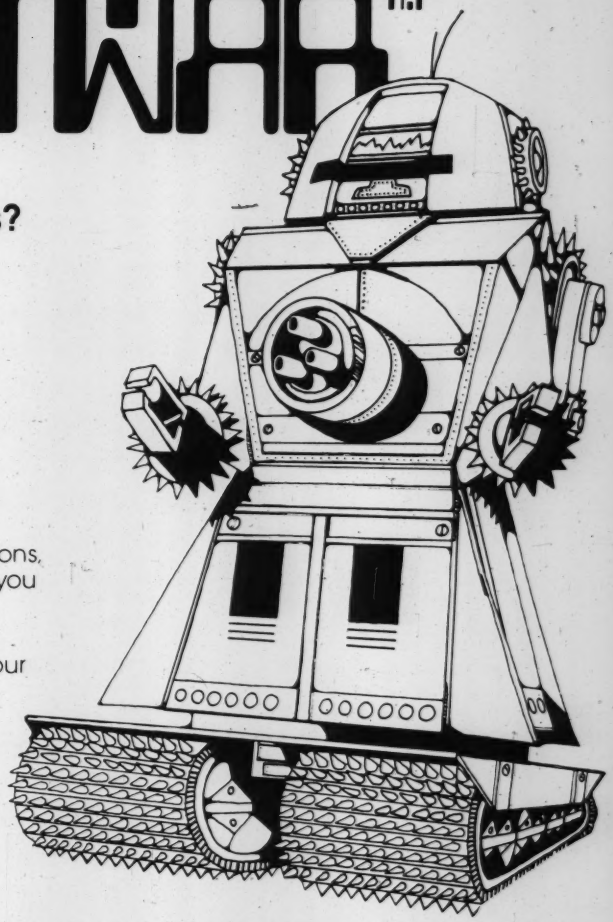

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New Graphics Horizons for the PET

Carl Strobel

Each time I tell myself that I've tried everything my computer has to offer—games, data processing applications, machine language programming, word processing—another door opens and I get a glimpse of a totally new horizon.

The latest world to conquer, and the most fascinating by far, is that of high resolution graphics. The possibilities seem almost as limitless as those which opened up when I first sat down with my brand new personal computer.

I've created a three-dimensional representation of my house and viewed it from any number of positions (including an underground worm's eye view), tracked satellites across a map of the world, designed a kitchen by moving cabinets and appliances around a three-dimensional room layout, created computer art and written in Japanese, and still I've just scratched the surface. There is a myriad of other uses, educational, business, personal and just plain fun (how about a cockpit view of landing a jet aboard an aircraft carrier, or a periscope attack on a merchant convoy).

The key to providing my PET with a relatively low cost, yet versatile high resolution graphics capability was the superbly conceived and engineered Visible Memory produced by Micro Technology Unlimited, 2806 Hillsboro St., Raleigh, NC 27605.

Carl Strobel, 1716 Tarleton Way, Crofton, MD 21114.

How It Works

The Visible Memory is based on a beautifully simple concept. To best understand how it works, let's take a quick look at the way graphics are created on the PET screen (the same principles generally apply to other microcomputers).

There are two methods commonly used to generate graphics on a computer screen. In vector graphics, found in more expensive computers, the desired shape is drawn on the face of the CRT. To make a 2" line slanting at a 17-degree angle, the electron beam is turned on at the starting point of the line and makes a trace two inches across the face of the CRT at a 17-degree angle.

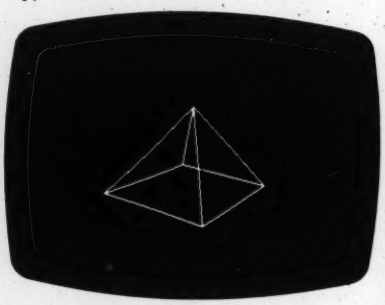
Raster graphics, used in most personal computers, is a little less direct. The electron beam moves in horizontal sweeps across the screen and is turned on and off in pulses, effectively making individual dots of light on the screen. The letter "T," for example is formed by turning the beam on for several consecutive pulses to form the crossbar, then adding the necessary dot in each of the next few horizontal sweeps to form the stem of the letter.

The raster method, while it does have some advantages, obviously produces a coarser picture. In practice, it also means the user is generally limited to those graphics symbols designed into the computer.

The PET screen is divided into 1000 blocks, 25 rows of 40 blocks each, in which a letter, number or graphics symbol can be displayed. Each block is composed

Figure 1. The Japanese character "Nihongo," meaning "Japanese language," as drawn by the Visible Memory. Any non-Roman alphabet can be produced.

Figure 2. A simple perspective drawing of a pyramid.



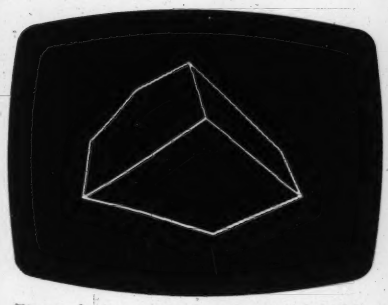


Figure 3. A perspective view (with hidden lines removed) of the author's house, as viewed from below—a worm's eye view.

of 64 potential dots of light called pixels, arranged in an 8 x 8 square. The pixels within a block are lit up in various combinations by the raster method described above to form any of the predefined symbols chosen by the user or designated by his program. In practice, the lefthand column and bottom row of pixels in each block are kept dark when forming alphanumeric characters in order to provide spacing between characters and between lines. But these pixels are available to form other symbols.

The graphic set of the PET is impressive, but it is also limited. In perspective drawings, for example, you can only create lines that are horizontal, vertical or at a 45-degree angle. Some clever art work has been accomplished using the graphics set (for example, the baseball players in Karl Savon's Batter Up! and the animated cartoons in *Cursor* magazine), but realistic or detailed drawings are not possible.

Consider, however, what would happen if you could light up any pixel you wished. You could not only draw lines at various angles to display objects in realistic perspective, but you could create any shape on the screen that you wanted—a map of Australia or the Chinese characters for "martini."

Enter the Visible Memory. Each bit in its 8K bytes of memory controls one pixel on the screen. Store a value of 1 in the bit and the pixel is turned on; a value of 0 keeps the pixel dark. The VM thus gives the PET owner 64,000 possible points of light with which to draw. They are arranged in 200 rows of 320 points each. The VM also includes several other very clever features which I will discuss later.

The key to the operation of the VM is an on-board graphic video generator which uses two of the inputs from the PET video display logic and adds a signal of its own. The PET generates vertical and horizontal drive signals used by the sweep circuitry

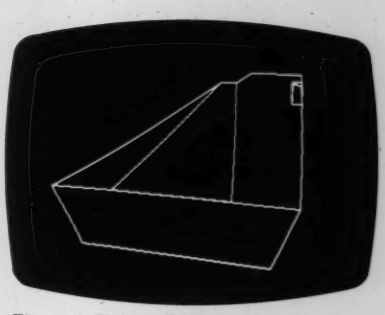


Figure 4. Flying a PET onto a carrier deck. The view is from a point 200' aft and about 50' above the flight deck.

in the monitor to control the movement of the electron beam across the face of the CRT. The PET also generates a display signal which turns the beam on and off to create graphics characters in the manner described above.

The VM video generator synchronizes itself with the two drive signals from the PET and creates its own video display signal which turns the beam on and off as directed by the graphics software, giving the user the ability to light individual pixels. Moreover, through a simple POKE command the user can select either PET video or VM video or overlay the two.

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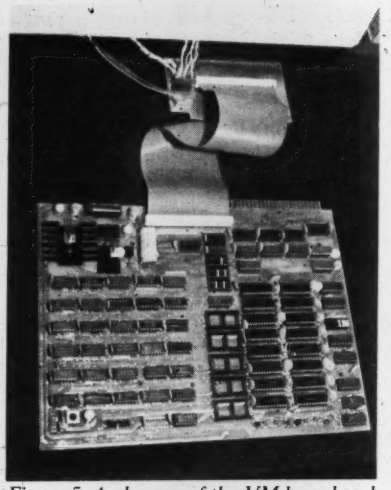

Figure 5. A closeup of the VM board and interface.

The overlay capability has been added to the latest version of the VM and gives the user added flexibility by allowing the PET alphanumerics set to be used with VM graphics. One practical application is to display place names on a VM-generated map at the user's request. A handy feature for teaching geography.

Another POKE command blanks the screen without affecting the PET or VM graphics in memory. This makes possible animation and other striking visual effects.

Additional Features

As mentioned earlier, the VM offers several other highly useful features not directly related to graphics. The board has five ROM sockets accessible by software command to allow use of the growing number of ROM programs, such as the Programmer's Toolkit and the Commodore Word Processor. The board also contains a light pen register (you supply the IC's) for additional flexibility in expanding your system. The comprehensive VM manual tells all you need to know to hook up the light pen and write the software necessary for its operation.

The ROMs, the visible memory and a KIM bus are all accessed through an enable control register using a POKE command. By setting the appropriate bit in the register, any of the devices may be made available as needed. It all sounds much more complicated than it really is; a chart in the VM manual explains what decimal value to POKE into the address in order to turn on the various devices. Jumpers are also supplied to allow the user to enable some of the devices at power-up.

The KIM bus, incidentally, allows the addition of other Micro Technology products such as memory expansion and a disk controller. Another Visible Memory can be added to provide gray scale graphics on an external monitor, using the bus.

But the one capability which made the VM cost effective for me was the ability to use its 8K of memory as additional RAM when not in the graphics mode.

This feature also gave me the only problem I have had with the VM. Initially I couldn't get my PET to recognize the existence of the additional 8K of RAM even though the VM worked perfectly in generating graphics. A little reflection and study of the VM manual showed that the unit as shipped had three ROM sockets enabled when the PET's power was turned on. The visible memory was then enabled by a POKE command to the enable control register. A quick change of jumpers to enable the memory at power-up solved the problem.

Installation

Installation of the VM is simple—and I speak as one who panics at the mere thought of opening the PET cabinet, much less touching anything inside.

The unit has two major components, the visible memory board itself and a connector board, along with the necessary cables. Two different types of connector boards are available to accomodate the varieties of PETs which have been produced.

The clear, step-by-step instructions provided in the manual give confidence to a non-hardware type such as myself. The connector board is plugged into the PET memory expansion connectors, three wires from the connector board are soldered to the large power diodes on the main logic board of the PET, the visible memory board is attached by cable to the connector board, another cable is plugged into the monitor circuitry of the PET, and the system is ready. The whole operation, including triple checking each step (I said I was cowardly about the inside of the PET), took 10 minutes. Brackets are available for mounting the VM inside the computer cabinet or the unit can be put in an external case.

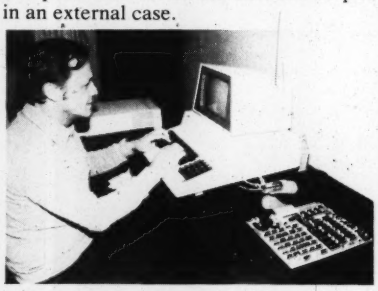

Figure 6. The VM attached to the author's PET. The board can be mounted inside the computer chassis or protected in an external cabinet.

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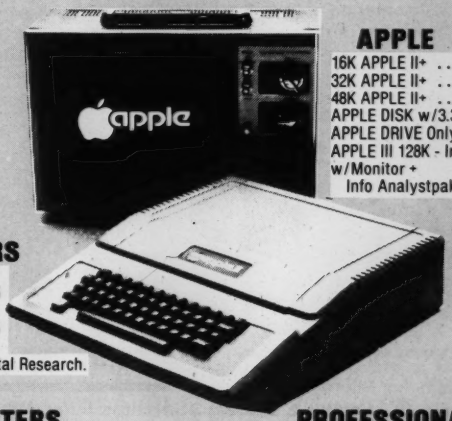

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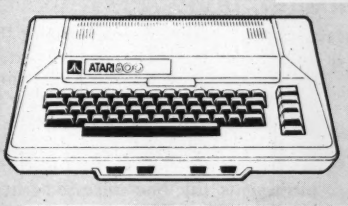

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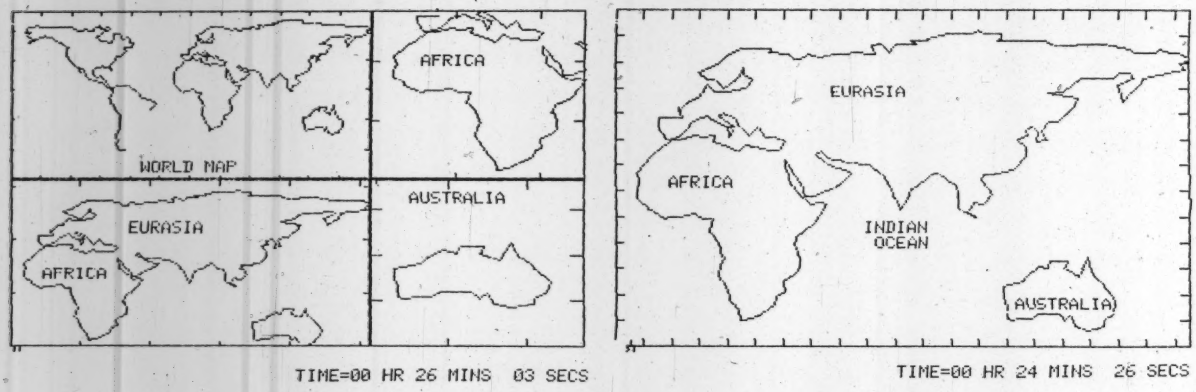

Figures 7 and 8. High resolution graphics printouts produced by a Commodore printer using a screen dump routine. The times show the amount of time required to print the contents of the screen—slow but effective.

The manual explains how to check each step of the installation, and a diagnostic program is included to verify proper operation of the memory when installation is finished.

Documentation

Technical documentation is excellent. There is a full description of the principles of operation, with schematics and pinout data included.

The manual contains a demonstration program in Basic for plotting a sine wave. The subroutines for converting X and Y coordinates into POKE addresses and values are easily adapted to a program of your own. The manual also explains the principles for programming the VM in Basic, along with the algorithms for calculating the byte address and bit number of any pixel.

Software

The easy way to program is to use the software package that Micro Technology offers separately. It contains a demonstration program that displays the impressive high resolution graphics capability of the system and has other programs which provide the ability to draw and write text. But most important, it contains machine language subroutines and a Basic interface routine which speed up the creation of graphics a hundredfold.

My three-dimensional graphics software uses those machine language subroutines to draw the figure. After calculating the coordinates of the two-dimensional projection of a given object, the Basic program calls the machine language routines to connect the vertices. It is much faster and less complicated than trying to draw directly with the Basic program.

For objects with many curved lines, such as maps, or with many short lines, such as Chinese characters, it is convenient to store the coordinates of the points as data statements and have a routine which reads them out and converts them to the byte addresses and bit values of the pixels.

In another language application, the PET keyboard can be converted to Hebrew. Each key represents a specific Hebrew letter. When a key is pressed the program draws the appropriate letter on the screen, writing from top to bottom and right to left.

The PET keyboard can be converted to Hebrew.

Micro Technology's graphics subroutines occupy about 1K in RAM, which leaves enough memory for any of the main programs which I've tried so far. Even the satellite tracking program with its world map, written by my friend Bill Crowell, just fits into the remaining 7K. However, a complex program, such as a game involving flying air strikes against moving targets over a realistic terrain, would probably require more than the minimum 8K on my PET. Additional memory is easily accommodated by the VM—just remember the address jumpers.

So far, the discussion has been about generating graphics on the monitor screen. A high resolution printout would be valuable for computer art or in computer-assisted design. Bill Crowell has written a machine language program which allows such a printout on a standard Commodore printer and is adaptable to any other printer which offers a user-defined character. Printing is slow, but the results shown in Figures 5 and 6, are effective.

In a future article, Bill and I will talk more about the high resolution printout routine, the programming of three-dimensional graphics, the satellite tracking software, and other graphics programs.

Price

The price of the memory board is $359, with the VM manual available separately for $10. The connector board for the PET 2001 is $35; the board for the 16/32K or CBM PET is $65. Internal mounting brackets, if desired, are $15 for the 2001 or $10 for other PETs.

A newly designed VM unit for the 80-column PET, which includes memory board, connector board and internal mounting brackets, is available for $495.

MTU also produces graphics software packages. The basic package containing machine language subroutines for rapid plotting is the one described here. It requires 2K of PET memory and costs $25. A more advanced graphics software package which adds more than 45 graphic commands to the PET Basic and provides a high level of sophisticated graphics programming costs $49. It requires 7.5K of PET memory and is available for all PET ROMs and the 80-column PET.

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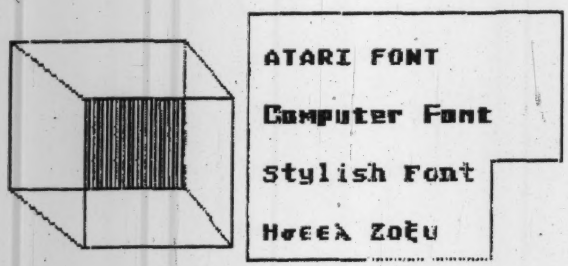
creative computing software evaluation

The Atari Graphics Composer

David Lubar



Cube was done using the draw-to and fill routines of the hi-res mode. Lettering was added in the text mode.

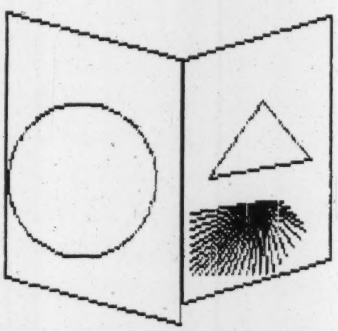
creative computing
SOFTWARE PROFILE

Name: Atari Graphics Composer
Type: Graphics utility
System: Atari 400 or 800, 32K RAM, Basic Cartridge, paddles or joystick.
Format: Disk or Tape
Language: Basic and Machine Language
Summary: Versatile system for graphic creation
Price: $39.95 on disk or tape
Manufacturer:
Versa Computing, Inc.
3541 Old Conejo Rd. Suite 104
Newbury Park, CA 91320

Everyone who has come within thirty feet of an Atari knows that the machine is capable of great graphics. Everyone who has come closer than that knows how tough it is to get those great graphics. By producing the *Atari Graphics Composer*, Versa Computing has taken care of the hard work, leaving the user free for creativity and experimentation. This set of utilities performs five main functions; hi-res drawing, medium-res drawing, text writing, geometric figure creation, and player creation. The combination is powerful enough to allow a wide range of graphics.

The high-res mode allows drawing with paddles or joystick on a four-color screen with a resolution of 320 by 160. There is one background color, which can be changed at any time, and three foreground colors. While the luminance of the foreground colors can be changed, the color value is predetermined by the background. In this mode, the user can either draw freestyle, or draw lines between any two points. Other options include fill and brush routines. There are two types of brushes; normal brushes fill an area with a solid pattern, the air brush puts a pattern of dots over an area. Combining these, one can color in a picture, then add shading. The fill routine, written in Basic, is not fast, but it is very thorough, filling in most irregular patterns without missing any spots.

Another nice feature is the accelerating crosshair. When the joystick is moved to a new position, the crosshair moves slowly at first, then speeds up. This allows for fine control over a small area and less waiting time when crossing the screen. While the quality of any graphics done in this mode depends, obviously, on the user's artistic ability, the capability is there to produce detailed pictures.



Figures and Moirē pattern made with the geo-maker.

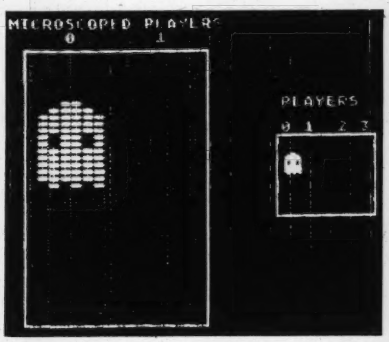
The medium-res mode provides a screen with 160 by 80 resolution, with one background and three foreground colors. These colors can be changed at any time. (For those unfamiliar with the Atari, a change in color actually changes a color register, thus not only do future lines appear in that new color, but lines drawn previously with that color also change to the new color.) As with the hi-res mode, medium-res also provides a fill routine and a selection of brushes.

The text mode places characters from any of four fonts on the hi-res screen. In the disk version of this package, users can switch between any of the modes using hi-res without losing the picture on the screen. Thus a scene can be drawn using the drawing mode, then labeled in the text mode. Along with upper and lower case, all special Atari symbols are supported. Also, the program will accept any user-generated fonts, though the documentation doesn't cover the process of font creation.

To write on the screen, the user first positions the cursor at the desired starting

point, using joystick or paddles, then types "T" for text. From that point until the escape key is pressed, all typed characters will be displayed on the screen. Editing keys such as delete still perform their usual function. If the user has switched to lower case, the program won't recognize any commands, but it will prompt the user to press the SHIFT and ALL CAPS keys.

The geo-maker mode allows the creation of a variety of geometric figures, from circles and arcs to triangles and parallelograms. Figures are defined by specifying points. A circle, for example, is defined by its center and any edge point. Triangles and parallelograms require three points. The circle and arc take the longest creation time, while other figures appear rapidly. The geo-maker includes a routine for Moire patterns. The user specifies the step value and, if desired, a window area, then uses the joystick or paddles to fill an area with the pattern.



Player creation is now a simple and dynamic process.

One of the most attractive features of the Atari is the ability to use players in animation. These shapes are usually coded by hand. The *Graphics Composer* has automated the process. Player creation is potentially the most valuable utility on the disk. It presents the user with a grid for designing players. Each large dot turned on in the grid is also displayed in true size on the screen. Once a player is created, it can be saved, and the decimal values representing the player can be displayed, allowing the user to put that player in his own programs.

Beyond explaining all the functions of the programs, the documentation also describes how to use the picture loading routine in other programs, thus making pictures created on this system retrievable by other software.

Anyone doing, or planning to do, graphics work on the Atari should seriously consider the *Atari Graphics Composer.* □

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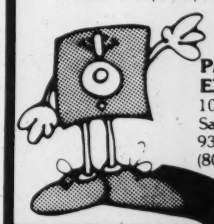

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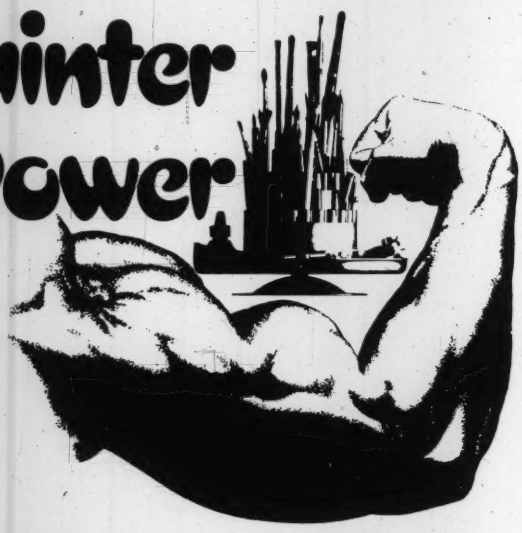
Painter Power



David Lubar

creative computing SOFTWARE PROFILE:

Name: Painter Power

Type: Abstract painting system.

System: 48K Apple, Applesoft, Disk Drive

Format: Disk

Language: Basic and Machine Language

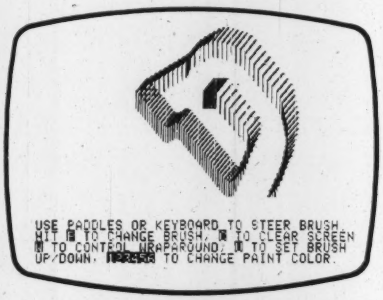
Summary: Fascinating and Fun

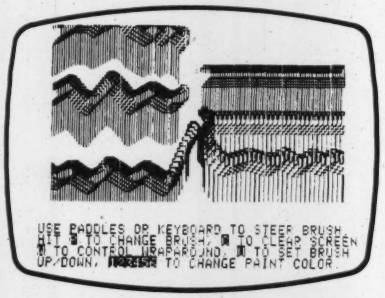
Price: $29.95

Manufacturer:
Micro Lab
2310 Skokie Valley Rd.
Highland Park, IL 60035

Eric Podietz held an audience enthralled with a dynamic creation of abstract art. The demonstration of his real-time graphics system was one of the highlights of the 1980 Personal Computer Arts Festival in Philadelphia. Using angled lines and shapes for brushes, Mr. Podietz put patterns on the screen, creating images reminiscent of weavings, abstract landscapes, and Escher stairways. He used an S-100 system and worked in black and white. But that was last year. During that time, he was not idle. He was busy creating an Apple version, adding extensions that make full use of color graphics and other Apple features. The result is *Painter Power*, a software package unlike anything else on the market. Two versions come with the disk; beginner and advanced. The beginner version gets the user going right away. The advanced version adds more power and a bit more complexity.

To use the beginner version, the painter selects a background color and a speed and gets down to creating. Using keys or paddles, the direction of the moving brush is controlled, putting marvelous images on the screen. If the brush is not to the user's liking, it can be changed easily. During creation, brush color can be changed, the brush can be lifted or set down, or the program can be frozen, allowing changes at the user's leisure. With wraparound set, the brush will reappear opposite the point at which it leaves the screen, and continue painting. With wraparound off, an image of the brush reappears, allowing the user to keep track of its relative location, but will not paint until it is returned to the actual screen. In essence, the painter (player?) has a neat little imagination box that seems to offer an infinite variety of images. Finished scenes can be created and saved to disk, or users can follow in the footsteps of Mr. Podietz and give real-time performances (with an appropriate musical accompaniment). Those who tested the program enjoyed it immensely, even in the beginner version.


USE PADDLES OR KEYBOARD TO STEER BRUSH.
HIT B TO CHANGE BRUSH, R TO CLEAR SCREEN
W TO CONTROL WRAPAROUND, U TO SET BRUSH
UP/DOWN, [illegible] TO CHANGE PAINT COLOR.


USE PADDLES OR KEYBOARD TO STEER BRUSH.
HIT B TO CHANGE BRUSH, R TO CLEAR SCREEN
W TO CONTROL WRAPAROUND, U TO SET BRUSH
UP/DOWN, [illegible] TO CHANGE PAINT COLOR.

Simple examples of designs created with Painter Power. The first uses the pre-defined brush from the beginner mode, the second was done with a user-defined brush in the shape of a question mark.

Advanced *Painter Power* adds all the extras that users of the beginner version might begin to wish for. While this version takes a bit more effort on the part of the user, the return is well worth the time spent learning the system. Not only can brushes be created, they can also be saved to disk. There is even the capability to create a special "Quickstroke" where a brush traces a predetermined pattern. And for those with a mathematical bent, a special routine allows the creation of brushes based on math functions. The location of the brush is displayed numerically at the bottom of the screen, aiding the user in keeping track of the brush when wraparound is turned off. There are many more features in the advanced system, and it would take days to explore all of them.

How does *Painter Power* differ from other painting programs? While you can probably reproduce its results with other systems, the fluidity and symmetry obtained by the moving brush make it the easiest system available for abstract designs. The strength of the program is its dedication to a specific area of graphics, and the ease with which it implements that approach.

While *Painter Power* deals with the abstract and is obviously not for everyone, it will delight anyone who is interested in creating patterns and designs, or just finding another way to have fun with the Apple.

Other Graphics

Several other Apple graphics programs arrived here too late to be covered in this issue. Notable among them is a graphics editor from SubLogic, that works in conjunction with their 3-D packages. The A2-GE includes a motion programmer. It will be reviewed here in the near future. Also, several vendors have new packages for shape table creation, animation, and other areas of graphics. These, too, will be explored in detail in upcoming issues. □

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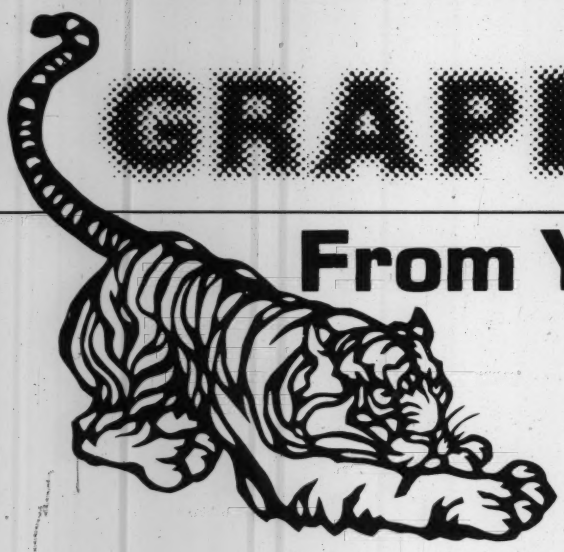

GRAPHS From Your Apple II

Robert Plamondon

The high resolution graphics capability of the Apple II is a versatile feature, indeed. Graphics are used for such varied purposes as space games, custom character sets, and, or course, graphs.

In the past the use of Apple-generated graphs was limited by the scarcity of programs to generate them, and the means to make permanent copies. Most printers lacked the ability to print graphs, and those that did required machine-language driver programs. Thus, graphic output from the Apple was used only by those who had both a suitable printer and a good deal of programming experience.

Fortunately, those days are now gone. Several popular printers, such as the Paper Tiger, Epson MX-70, and some daisy-wheel printers have graphics capability, either as a standard feature or as an inexpensive option. In addition, several software houses have released programs which allow you to create and print your own graphs.

Scientific Plotter

Scientific Plotter from Interactive Microware and Creative Computing Software is available on diskette for 48K Apples with ROM Applesoft, and comes with about 30 pages of mildly confusing documentation.

This package is designed specifically for lab scientists who want to be able to make neat graphs of experimental data. The only kind of graph it makes is the x-y plot; if you want bar graphs or pie charts, this is not the program for you.

Scientific Plotter produces a graph of your data points, with each point represented by a circle, square, cross, or star. Each of these symbols is available in four sizes. You can add error bars if you like, and the points can be connected by straight lines, or not, at your option.

The great advantage of the program is that it lets you play with the format of your graph, and scale it exactly to your needs. When drawing graphs by hand, your choices of format and scale are limited by the types of graph paper you have at your disposal. Drawing graphs by hand is also tedious and error-prone—just the kind of thing you'd like to fob off onto a computer.

Scientific Plotter has an impressive array of options. You can type in data points by hand, calculate them in subroutines, or pull them off a disk file. You have full control of the size of the graph, the location of the axes, the scale, and the color of the data points. The format of the graph, the data, and the graph itself can be saved and retrieved from the data. Labels can be placed anywhere on the graph in any of four orientations and in any hi-res color. And there are many other useful features; too many to cover in a review.

The program works by asking you a series of questions. It starts by printing:

```
NAME OF FORMAT FILE ()?
<NONE>
```

Format files hold all the information on scaling, labels, and whatnot that the program needs to make a graph. The two parentheses generally hold the range of

Robert Plamondon, 667 SW 15th Street, Corvallis, OR 97330.

creative computing

SOFTWARE PROFILE

Name: Scientific Plotter

Type: 48K Apple, Applesoft, Disk drive

Format: Disk

Language: Applesoft

Summary: Quality graphing program

Price: $24.95

Manufacturer:

Interactive Microware, Inc.
P.O. Box 771
State College, PA 16801
or
Creative Computing Software
39 E. Hanover Ave.
Morris Plains, NJ 07950

Drawing graphs by hand is also tedious and error-prone — just the kind of thing you'd like to fob off onto a computer.

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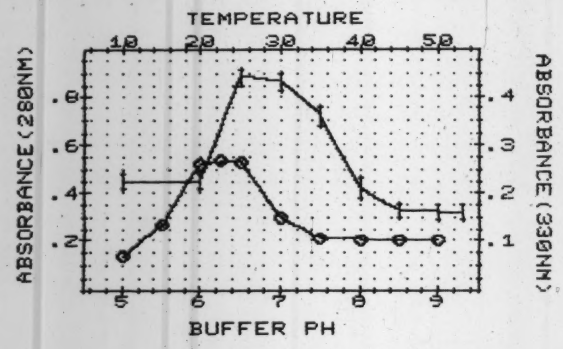


A sample graph mode by Scientific Plotter. Printed in normal plot mode by Paper Tiger Graphics.

values an answer can take; in this case, your response can be anything you want, so there are no limits shown. The "NONE" indicates that if you hit return without typing anything, the program assumes you don't want to load a format file. "NONE" is the default answer.

There are quite a few questions, and answering all of them (if only by the default value) can take a long time, especially when you make mistakes. Fortunately, the default value is equal to the last value you have entered, so you type only the corrections, and hit return on all the other questions. If you read in a format file at the beginning of the cycle, the values in the file become defaults. This can also save time, since most graphs have many parameters in common.

As a final time-saver, Control-A causes the program to step through the questions automatically, assigning the default value to each quantity. This can be stopped by hitting any key. This feature lets you flash past the routine questions and stop only where changes must be made.

As the questions are answered, the program gets the information it needs to start the graph. As soon as you input the position of the x-axis, the program displays the hi-res graphics page, draws the x-axis, and returns to text mode. This sequence of input, plotting, and return to text mode occurs every time the program puts something on the graph, and lets you see what you are building.

The labeling feature is very flexible.

Unfortunately, there is no way to back up to fix a mistake on the previous question. Instead, you must start over. This is the worst flaw in the program.

The labeling feature is very flexible; labels can be placed in any of four orientations, anywhere on the screen. A ridiculously large number of labels can be placed on a graph.

One method of placing labels and axes on the graph is the Cursor command which places a small cross on the hi-res display. This cross can be moved by game paddles or a joystick, and is used to designate the starting position of a label or a coordinate axis without guessing x and y values.

My initial reaction to this program was massive frustration at the difficulty of correcting errors, followed by great satisfaction at the quality of my graphs. Once I had a few format files on disk, I found that I could make graphs with a few non-default values, and everything moved very quickly.

I have found Scientific Plotter to be a very useful program, and a genuine bargain at $25.

Paper Tiger Graphics

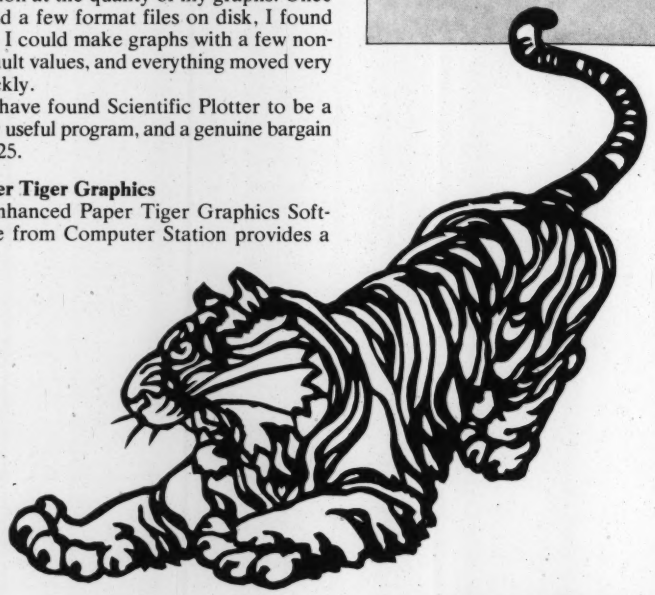
Enhanced Paper Tiger Graphics Software from Computer Station provides a way to transfer the contents of the hi-res graphics screen to your printer, assuming that you have a Paper Tiger 440 or 445 with graphics, as I do. Computer Station also sells graphic dump programs for the Paper Tiger 460G, Anadex 9501 and the NEC Spinwriter, which I assume are similar to the one for the Paper Tiger 440G.

Computer Station takes the problem of putting the contents of the screen onto a piece of paper, solves it elegantly, and wraps a truly foolproof control section around it. The program gives you a printout very quickly; its speed is limited mostly by the speed of the printer interface card. The program is menu-driven, and the menu is the best I have ever seen. The whole program is a joy to use.

The only fly in the ointment is that you have to tell it what kind of interface card you have, and in which slot it is located. If you have trouble remembering the card you have, and where you put it, this can slow you down.

creative computing
SOFTWARE PROFILE

Name: Enhanced Papter Tiger Graphics
Type: Hi-res screen dump
System: 48K Apple, Disk drive, IDS 440G/445G
Format: Disk
Language: Machine language
Summary: Quick and elegant
Price: $44.95
Manufacturer:
Computer Station
12 Crossroads Plaza
Granite City, IL 62040



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INSTANT ASSEMBLER is absolutely unique among tape based assemblers in that it produces relocatable code modules that can be linked with the separate LINKING LOADER, which is supplied in two versions for loading programs into either high or low RAM. This lets you build long programs with small modules. INSTANT ASSEMBLER also features immediate detection of errors as the source code is entered, a compactly coded source format that uses 1/3 as much memory as standard source, and many operational features including single stroke entry of DEFB and DEFW, pinpoint control of listings, alphabetic listing of symbol table, separate commands for listing error lines or the symbol table, block move function, and verification of source tapes.

INSTANT ASSEMBLER's debugger provides single stepping with full register displays, decimal or hex entry of addresses, forward or backward memory displays, disassembly of object code in memory, memory display in ASCII format, and hex-to-decimal or decimal-to-hex conversion. The single-stepper will step one instruction at a time or at a fast rate to any defined address.

INSTANT ASSEMBLER occupies less than 8400 bytes of memory. In a 16K machine this will leave you enough memory to write assembly language programs of around 2000 bytes. This and its module-linking feature make INSTANT ASSEMBLER ideal for users with only 16K machines. The instruction manual may be purchased separately for $3, which will apply towards the purchase of the INSTANT ASSEMBLER.

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STEP80 allows you to step through any machine language program one instruction at a time, and see the address, hexadecimal value, Zilog mnemonic, register contents, and step count for each instruction. The top 14 lines of the video screen are left unaltered so that the 'target program' may perform its display functions unobstructed. STEP80 will follow program flow right into the ROMs, and is an invaluable aid in learning how the ROM routines function. Commands include step (trace), disassemble, run in step mode at variable step rate, display or alter memory or CPU registers, jump to memory location, execute a CALL, set breakpoints in RAM or ROM, write SYSTEM tapes, and relocate to any page in RAM. The display may also be routed to your line printer through the device control block so custom print drivers are automatically supported.

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This machine language program may be used as a smart terminal with time share systems or for high speed file transfers between two disk-based micros over modems or direct wire. It is menu driven and extremely simple to use. Functions include real-time terminal mode, save RAM buffer on disk, transmit disk file, receive binary files, examine and modify UART parameters, program 8 custom log-on messages, automatic 16-bit checksum verification of accurate transmission and reception, and many more user conveniences. Supports line printers and lowercase characters. With this program you will no longer need to convert machine language programs to ASCII for transmission, and you will know immediately if the transmission was accurate. This program comes on a formatted disk.

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Assemble an alphabetized index of your entire program library from disk directories. Program names and free space are read automatically (need not be typed in) and may be alphabetized by disk or program. The list may also be searched for any disk, program, or extension; disks or programs added or deleted; and the whole list or any part sent to the printer. Printer output may be requested in three different formats including labels. The list itself may also be stored on disk for future access and update. It also includes a PURGE mode for quickly killing unwanted files. Directory reads and alphabetizing is done in machine code for speed. 1,000 programs may be sorted in less than 10 seconds. Works with TRSDOS, NEWDOS, and NEWDOS/80 single or double density. One drive and 32K required.

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Make duplicate copies of any tape written for Level II. They may be SYSTEM tapes or data lists. The file name, load address, entry point, and every byte (in ASCII format) are displayed on the video screen. Model III version allows changing tape speed.

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ORDERING: Complete satisfaction is guaranteed or a full refund will be made. All programs (except TELCOM) are shipped on cassette unless $5 is included for a formatted (no system) disk. Include $1.50 for postage and handling. California residents add 6% sales tax. Visa, Mastercharge and COD orders accepted. SPECIFY MODEL I OR MODEL III. Dealer inquiries invited.

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A reproduction of the famous self-portrait of Leonardo da Vinci, done in expanded plot mode, by Paper Tiger Graphics.

Graphs, continued...

The program lets you print either of the hi-res pages, in either normal (4 3/8" x 2 3/4") or expanded (6 1/2" x 5 3/8") modes. The larger size makes pictures large enough to hang on a wall. You can print either a positive or a negative image (i.e., either a white or a black background); justify the output to the left, center, or right of the page; display the graph before printing it; and load pictures from disk without stopping the program. All in all, the package is very well done.

The software comes with adequate documentation, and a large number of sample graphs and pictures.

Enhanced Paper Tiger Graphics Software runs on the Apple II and Apple II Plus, and costs $44.95. □

L I S P

for the Apple II

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VISA

Applesoft in ROM or a language card is needed for floating point math.

gnosis

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Softlights

By Fred Huntington

More and more fantastic things are becoming available for the Apple®. We just received one of my favorites – the **Passport Designs SOUNDCHASER Computer Music System.** It's easy to set up and an absolute blast to play with.

Price is $650 for the keyboard and $350 for each synthesizer board.

We recommend two boards. When you buy the complete system, we will give you $100 worth of free software (your choice from our current catalog).

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TEXT & GRAPHICS

Options for Apple and Epson

Alan Tobey

Two new options for owners of the Apple II computer and the Epson MX-80 printer can greatly extend the abilities and the ease of use of this popular combination. For little additional cost, these products give the user 24 different print modes with the MX-80, sophisticated graphics routines, and very simple firmware control of many of the printer's text and format features.

The full range of these features is available only to those who have both an Apple and an Epson, but users of Apples who have other graphics printers—or MX-80 owners with other computers—can take advantage of at least one part of this powerful pair.

The Grappler Interface

The Grappler Interface, from Orange Micro, is a parallel interface card for the Apple. Its on-board ROM is provided in a specific version for each compatible printer—currently all Anadex and Epson printers, IDS Paper Tigers with graphics, and the Centronics 739. The Epson MX-80 requires Graftrax-80, described below. Future graphics printers will also be accommodated.

The Grappler Interface gives the user simple control of several useful text and graphics routines. The Grappler's functions are invoked by simple commands either from the keyboard or from within a program. All commands begin with "Control-I" from Basic or "Control-Y" from Pascal or CP/M, and usually require entering just a single additional character to set each feature.

Text Features

The most important text function of the Grappler is a text screen dump routine. With only a Ctrl-I "S" command, whatever is on the Apple CRT text screen will be printed out automatically, with a 20-character left margin that centers the text on the printout page. (One inconvenient limitation: only the standard 40-character Apple display can be dumped; 80-column boards are not supported.) With similar commands, the Grappler can set or change left and right margins, line length and page length (with an automatic six-line skip-over-perforation feature).

The Grappler Interface gives the user simple control of several useful text and graphics routines.

The screen dump routine is a very handy feature for printing out the results of programmed calculations when the printout routines have not been included in the program, or for printing partial listings of program sections you may want to think about before editing.

The text screen can be dumped any time the cursor is active (blinking), so you can, for example, print out the text screen when the program is halted for a keyboard input without disrupting further program execution. The cursor disappears while the screen is being printed, and then returns, ready for your input as if nothing had happened.

A minor annoyance is the inability of the Grappler to initiate horizontal tabs beyond the 40th column in the normal way; instead a single POKE command is required. This isn't a limitation—just a quirk the user must remember.

Graphics Features

The Grappler treats the Apple graphics in a manner similar to the way it treats the text screen. Short commands allow the Apple to send the stored contents of either hi-res graphics page one or page two to the printer, where it can be printed normally (black-on-white), inverse (white-on-black), double-size, and/or rotated 90°. In the rotated mode the printer can emulate a chart recorder by printing a series of rotated page images in sequence.

Since until now the only way to dump the Apple graphics pages to a printer has been to load (or type in) a fairly elaborate software routine, the Grappler offers tremendous advantages in convenience and savings in programming time. With the Grappler, a few keystrokes get you a graphics printout, from inside a program or as a direct command. It's so easy to do that it encourages frequent and almost whimsical use, just to have a copy of what is stored in the graphics pages. My kids love drawing pictures on the CRT with the joystick and then getting a hard-copy printout to tear off and color.

In addition to graphics dumps, the Grappler can supply the MX-80 (and "some" other printers which the manual doesn't identify) with the missing eighth bit required for TRS-80 block graphics. (The Apple II outputs only seven bits.) That is a delightful feature; one of the few advantages the TRS-80 has had to make Apple owners jealous is neatly eliminated—on paper, at least.

Orange Micro has recently revised and expanded the Grappler documentation from an early primitive version. (I originally received four pages of instructions and one page of corrections.) The current 18-page manual is written in real English—clear and unambiguous—and seems quite complete. An insert even provides a program to modify Visiplot for use with the Grappler.

The Grappler Interface should be useful to every Apple user who owns—or plans to buy—a graphics printer. With a list price of $165 ($15 less than the list for Apple's own parallel printer interface card) it's even a bargain.

Orange Micro Inc., 3150 E. La Palma, Suite G, Anaheim, CA 92806. (714) 630-3322.

Alan Tobey, 1228 Peralta Ave., Berkeley, CA 94706.

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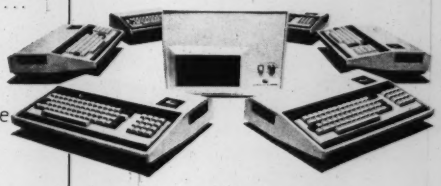

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Graftrax-80

Graftrax-80 is a kit that gives the Epson MX-80 printer bit-graphics capability. It does not require an Apple but will work with any computer that will drive the regular MX-80. (One exception: it will not work with the Epson 8141 serial interface.) Installing it requires pulling one IC and plugging three others into sockets provided in the MX-80, cutting one jumper wire on the circuit board of the printer, and resetting several DIP switches. Directions for doing this are very clear, and an unusually good line drawing (for once no murky photograph) makes the chance of an error virtually nil. Even a full-fledged fumblefingers should not feel intimidated.

Although Graftrax-80 is advertised as a graphics add-on, one of its most useful features is a text printout enhancement. The kit adds an italics print mode to the options already provided by the standard MX-80. This doubles (to a total of 24) the number of different print modes the MX-80 can print.

All of the regular variations and combinations of type style—using normal, emphasized, double-width, compressed and double-strike print—can also be printed in italics. This gives tremendous versatility to an already excellent printer and provides a variety of type styles for almost every conceivable purpose, from extra-bold headings to normal 80 cps print.

Graftrax-80 is a kit that gives the Epson MX-80 printer bit-graphics capability.

Each print mode variation is established using simple escape codes, and with Graftrax-80 all can be turned on and off even in the middle of programmed print lines (not true with the standard MX-80). This makes sophisticated control of the printout quite simple. One example: I've set up an MX-80 to print product labels at my business. I wrote a short utility program in Applesoft that uses string concatenation to condense all the possible combinations of printer function codes into string variables. For instance, once I've set up DI$=CHR$(27)+CHR$(83)+CHR$(27)+CHR$(52)—equivalent to "ESC S ESC 4"—I can shift to double-width italic printing at any point in a printout routine with just a "PRINT DI$" statement. I load a complete routine as the beginning of a label-printing program, and then programming printout type style becomes almost as fast and as automatic as shifting to upper case.

Graftrax-80, however, is mainly a graphics enabler. Its major function is to add to the MX-80 the bit-graphics capabilities that the Epson MX-70 and MX-100 already have. In bit-graphics mode, any of the top eight printhead needles can be fired at any of 480 or 960 horizontal positions per line. This means that almost any point on the paper can be printed black or left white for truly high-resolution graphics. Graftrax-80, then, brings the MX-80 up to par with other graphics printers such as the Anadex series or the IDS Paper Tigers.

Graftrax-80 will also support TRS-80 block graphics for Apple users, independent of the Grappler. Once block graphics mode is entered via an escape code, each block graphic character is specified with a single ASCII code, so many graphics printout effects can be programmed much more quickly than in the laborious bit-plot mode.

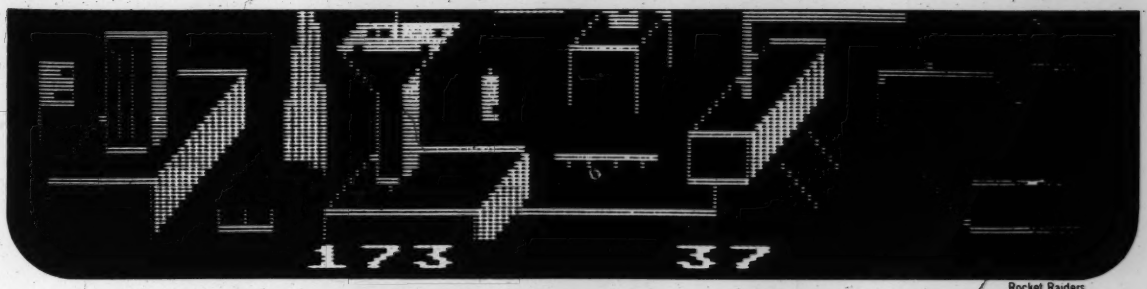
There are several quirks of which the user should be aware. The Apple II doesn't pass the Decimal 9 or Decimal 13 character to the MX-80 with Graftrax in a way that the printer can properly interpret. The TRS-80 Model I has the same problem with Decimal 0, 10, 11 and 12. This means that certain tab and paper feed functions can't be specified conveniently; but the Graftrax manual includes reasonably short POKE routines as acceptable fixes.

Any one of its features would make Graftrax-80 well worth its additional $90 (list) cost. Together, they make an already great printer even better and put highly sophisticated printout routines within easy reach of even inexperienced programmers. I wouldn't have an MX-80 without it.

Epson America, Inc., 3415 Kashiwa St., Torrance, CA 90505. (213) 539-9140. □

EPSON MX-80 PRINT MODES WITH GRAFTRAX

1. THIS IS NORMAL PRINT.
2. THIS IS NORMAL ITALIC PRINT.
3. THIS IS NORMAL EMPHASIZED PRINT.
4. THIS IS NORMAL EMPHASIZED ITALIC PRINT.
5. THIS IS NORMAL DOUBLE-STRIKE PRINT.
6. THIS IS NORMAL DOUBLE-STRIKE ITALIC PRINT.
7. THIS IS NORMAL EMPHASIZED DOUBLE-STRIKE PRINT.
8. THIS IS NORMAL EMPHASIZED DOUBLE-STRIKE ITALIC PRINT.
9. THIS IS COMPRESSED PRINT.
10. THIS IS COMPRESSED ITALIC PRINT.
11. THIS IS COMPRESSED DOUBLE-STRIKE PRINT.
12. THIS IS COMPRESSED DOUBLE-STRIKE ITALIC PRINT.
13. THIS IS DOUBLE-WIDTH PRINT.
14. THIS IS DOUBLE-WIDTH ITALIC PRINT.
15. THIS IS DOUBLE-WIDTH EMPHASIZED PRINT.
16. THIS IS DOUBLE-WIDTH EMPHASIZED ITALIC PRINT.
17. THIS IS DOUBLE-WIDTH/DOUBLE STRIKE PRINT.
18. THIS IS DOUBLE-WIDTH/DOUBLE STRIKE ITALIC PRINT.
19. THIS IS DOUBLE-WIDTH/DOUBLE STRIKE EMPHASIZED PRINT.
20. THIS IS DOUBLE-WIDTH/DOUBLE STRIKE EMPHASIZED ITALIC PRINT.
21. THIS IS DOUBLE-WIDTH COMPRESSED PRINT.
22. THIS IS DOUBLE-WIDTH COMPRESSED ITALIC PRINT.
23. THIS IS DOUBLE-WIDTH COMPRESSED DOUBLE STRIKE PRINT.
24. THIS IS DOUBLE-WIDTH COMPRESSED DOUBLE STRIKE ITALIC PRINT.



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☐ **PM EDITOR:** by Dennis Zander (Atari, 16K)
Create your own fast action graphics game for the Atari 400 or 800 using its player missile graphics features. By using player data stored as strings, players can be moved or changed (for animation) at machine language speed. All this is done with string variables (PO$(Y)=SHIP4). This program is designed to permit creation of up to 4 players on the screen, store them as string data and then immediately try them out in the demo game included in the program. Instructions for use in your own game are included. PM EDITOR was used to create the animated characters in **ARTWORX** RINGS OF THE EMPIRE and ENCOUNTER AT QUESTAR IV.
PRICE ..... **$29.95** cassette **$33.95** diskette

☐ **ROCKET RAIDERS** by Richard Petersen (Atari 24K)
Defend your asteroid base against pulsar bombs, rockets, lasers, and the dreaded "stealth saucer" as aliens attempt to penetrate your protective force field. Precise target sighting allows you to fire at the enemy using magnetic impulse missiles to help protect your colony and its vital structures.
PRICE ..... **$19.95** cassette **$23.95** diskette

☐ **INTRUDER ALERT!** by Dennis Zander (Atari, 16K)
This is a fast paced action game in which you must escape from the "Dreadstar" with the secret plans. The droids are after you and you must find and enter your ship in order to escape. If you fail, the rebellion is doomed. **PRICE** ....**$16.95** cassette **$20.95** diskette

☐ **THE RINGS OF THE EMPIRE:** by Dennis Zander (Atari 16K)
The Empire has developed a series of battle stations protected by one or more rings of energy. You must destroy these weapons by attacking them in your Y-wing fighter armed with Zydon torpedoes. Each time you blast through the rings and destroy the station, the Empire develops a new station with more protective rings.
PRICE ..... **$16.95** cassette **$20.95** diskette

☐ **FOREST FIRE!:** by Richard Petersen (Atari,24K)
Using excellent color graphics, your Atari is turned into a fire scanner to help you direct operations to contain a forest fire. You must compensate for changes in wind, weather and terrain. Not protecting valuable property can result in startling penalties. Life-like variables make FOREST FIRE a very suspenseful and challenging simulation. **PRICE** ..... **$16.95** cassette **$20.95** diskette

☐ **PILOT:** by Michael Piro (Atari, 16K)
Pilot your small airplane to a successful landing using both joysticks to control throttle and attack angle. PILOT produces a true perspective rendition of the runway, which is constantly changing. Select from two levels of pilot proficiency.
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☐ **ALPHA FIGHTER:** by Douglas McFarland (Atari, 16K)
Consisting of two different programs, ALPHA FIGHTER requires you to destroy the alien starships. As you become more successful, the games get harder and and harder. **PRICE** .... **$14.95** cassette **$18.95** diskette

☐ **GIANT SLALOM:** by Dennis Zander (Atari, 16K)
Bring the Winter Olympics to your computer anytime of the year! Use the joystick to guide your skier's path down a giant slalom course consisting of open and closed gates. Choose from three levels of difficulty. Take practice runs or compete against from two to eight additional skiers.
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☐ **HODGE PODGE:** by Marsha Meredith (Apple 48K, Applesoft or Integer BASIC)
This captivating program is a marvelous learning device for children from 18 months to 6 years. HODGE PODGE consists of many cartoons, animations and songs which appear when any key on the computer is depressed. A must for any family containing young children and an Apple.
PRICE ..... **$19.95** diskette

☐ **HEARTS 1.5:** by Arthur Walsh
(Atari 24K, Apple, TRS-80, PET, North Star and CP/M (MBASIC) systems).
You are pitted against two computer opponents in this popular card game. The program employs a hard-to-beat playing algorithm which creates quite a challenge for even the advanced player.
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NOMINOES JIGSAW (Atari, 24K) ..... **$17.95 / $21.95**
Please specify "TNT" version when ordering programs.

☐ **CRANSTON MANOR ADVENTURE:** by Larry Ledden (Atari, North Star and CP/M)
You must enter mysterious Cranston Manor and attempt to collect its many treasures. This extemely challenging program will provide you with many hours (days?) of adventure. The program may be interrupted at will and your status saved onto the diskette.
PRICE ..... **$21.95** diskette

☐ **STUD POKER:** by Jerry White (Atari, 16K)
This is the classic gambler's card game. You will find the computer to be a worthy opponent who occasionally bluffs but never cheats! STUD POKER employs all of the Atari's sound, color and graphics capabilities.
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☐ **TEACHER'S PET:** by Arthur Walsh (Atari, Apple, TRS-80, PET, North Star and CP/M (MBASIC) systems).
This is an introduction to computers as well as a learning tool for the young computerist (ages 3-7). The program provides counting practice, letter-word recognition and three levels of math skills.
PRICE ..... **$14.95** cassette **$18.95** diskette

☐ **FORM LETTER SYSTEM:** (Atari, North Star and Apple)
This is the ideal program for creating personalized form letters! FLS employs a simple-to-use text editor for producing fully justified letters. Addresses are stored in a separate file and are automatically inserted into your form letter along with a personalized salutation. Both letter files and address files are compatible with **ARTWORX** MAIL LIST 3.0 and TEXT EDITOR programs.
PRICE ..... **$39.95** diskette

☐ **TEXT EDITOR:** (Atari and North Star)
This program is very "user friendly" yet employs all essential features needed for serious text editing with minimal memory requirements. Features include common sense operation, two different justification techniques, automatic line centering and straightforward text merging and manipulation. TEXT EDITOR files are compatible with **ARTWORX** FORM LETTER SYSTEM.
PRICE ..... **$39.95** diskette

☐ **MAIL LIST 3.0:** (Atari, Apple and North Star)
The very popular MAIL LIST 2.2 has now been upgraded. Version 3.0 offers enhanced editing capabilities to complement the many other features which have made this program so popular. MAIL LIST is unique in its ability to store a maximum number of addresses on one diskette (typically between 1200 and 2500 names!). Entries can be retrieved by name, keyword(s) or by zip codes. They can be written to a printer or to another file for complete file management. The program produces 1, 2 or 3-up address labels and will sort by zip code (5 or 9 digits) or alphabetically (by last name). Files are easily merged and MAIL LIST will even find and delete duplicate entries! The address files created with MAIL LIST are completely compatible with **ARTWORX** FORM LETTER SYSTEM.
PRICE ..... **$49.95** diskette

☐ **THE VAULTS OF ZURICH:** by Felix and Ted Herlihy (Atari, 24K, PET)
Zurich is the banking capital of the world. The rich and powerful deposit their wealth in its famed impregnable vaults. But you, as a master thief, have dared to undertake the boldest heist of the century. You will journey down a maze of corridors and vaults, eluding the most sophisticated security system in the world. Your goal is to reach the Chairman's Chamber to steal the most treasured possession of all: THE OPEC OIL DEEDS!
PRICE ..... **$21.95** cassette **$25.95** diskette

☐ **BRIDGE 2.0** by Arthur Walsh (Atari (24K), Apple TRS-80, PET, North Star and CP/M (MBASIC) systems)
Rated #1 by Creative Computing, BRIDGE 2.0 is the only program that allows you to both bid for the contract and play out the hand (on defense or offense!). Interesting hands may be replayed using the "duplicate" bridge feature. This is certainly an ideal way to finally learn to play bridge or to get into a game when no other (human) players are available.
PRICE ..... **$17.95** cassette **$21.95** diskette

☐ **ENCOUNTER AT QUESTAR IV:** by Douglas McFarland (Atari, 24K)
As helmsman of Rikar starship, you must defend Questar Sector IV from the dreaded Zentarians. Using your plasma beam, hyperspace engines and wits to avoid Zentarian mines and death phasers, you struggle to stay alive. This BASIC/Assembly level program has super sound, full player missile graphics and real time action.
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☐ **THE NOMINOES JIGSAW PUZZLE:**
by C. Minns/B. Brownlee (Atari, 24K, TRS-80, and Apple)
We quote . . ."A brainteaser supreme. . . the concept of NOMINOES JIGSAW is brillant. . . this video jigsaw game is so clever and completely original that only the most hardhearted puzzle hater could fail to be charmed."—ELECTRONIC GAMES MAGAZINE.
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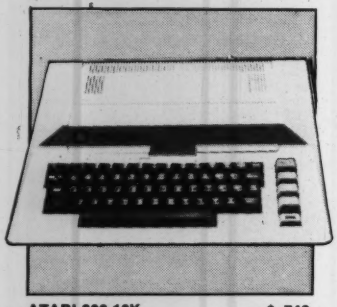

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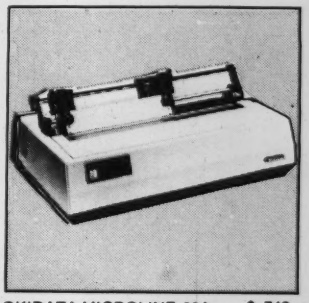

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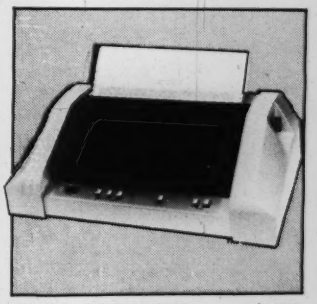

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MORE... ON VIC GRAPHICS

Bob Yannes

We recently received the following information concerning the VIC-20 from Bob Yannes, an engineer at Commodore. The article describes some capabilities of the VIC which were not mentioned in my original review in the September Buyer's Guide. *Bob was surprised that I did not mention these features.*

My article was written using only the manuals and other materials furnished to normal, everyday purchasers of the VIC computer. I noted in the article that no programmer's reference guide was available. Apparently it still isn't. I also noted that the one manual furnished had some major shortcomings. It still does. Thus, while we are happy to hear about the additional capabilities of the VIC-20, we are disappointed that purchasers will have to read Creative Computing *or some non-Commodore book or manual to learn how to use these features.*

We feel that the VIC offers excellent price performance. This is enhanced by the fact that Commodore recently entered into a contract with Bally to provide cartridges of all of Bally's coin-op games for the VIC. This could not be done on a computer that did not offer good graphics and animation capabilities. However, at this point, Commodore is not supplying the necessary information to the user so that he can make use of the graphic capabilities. This we view as a serious shortcoming.—DHA

The VIC is capable of a full bit-mapped display in which each of 28160 pixels is individually addressable. The VIC-20 offers three basic display modes. The "standard" text mode consists of the upper/lower case character set and PET graphics characters which are available from the keyboard.

The second display mode allows the user to define his own character set for special symbols, foreign languages and game characters. The user can either define all 256 characters, or define half and use half of the character ROM.

The third display mode is a 176H by 160V bit-map display with each pixel addressable. Within each of these modes there is a sub-mode which reduces horizontal resolution but improves color flexibility.

The multiple display modes allow users to get more out of their VICs as their expertise increases. Beginners can create graphics easily from the keyboard, while more sophisticated users can take advantage of the definable characters and bit-map.

A plain vanilla, unexpanded VIC-20 contains enough RAM for the full bit-map. An unexpanded VIC-20 does not have enough RAM for complicated programs using the bit-map, but plug-in cartridges (such as games) can use the bit-map effectively.

The real power of the bit-map is available to the user when he purchases the Super Expander cartridge which not only provides extra RAM, but also adds a host of graphics and music commands to VIC Basic.

The 22 by 23 character display format was chosen to keep costs down (the fewer characters displayed, the less memory is required to hold them) and to eliminate the complaints normally associated with color video displays. Color televisions were never designed to display small color dots and create many problems for beginners with graphics.

If a dot is too small, the television will only display a smudge or nothing at all. Depending on the rate the dots are shifted out to the TV, the TV may also produce all sorts of undesirable color fringing, even on a black and white image (Apple actually uses this color fringing effect to create their hi-res colors).

The VIC was designed to eliminate these effects by making the dots large enough for the TV to display properly and shifting the dots out at a special rate. It is, therefore, possible to pick any color combination on the VIC without worrying about how to fudge the characters to compensate for the TV problems.

All of this is handled by the Video Interface Chip used in the VIC-20, which not only handles the display but also provides the light pen interface, paddle interfaces and sound generator, making it one of the most flexible display chips around. The high speed of the VIC-20 is a result of the transparent DMA technique used by the video chip which never stops or slows the 6502 processor. □

Bob Yannes, 109 E. 4th St., Media, PA 19063.

Lynn Busby, president of the Computer Station, as seen by the Dithertizer II.

You and your Apple can have a new view of the world.

Dithertizer!

Dithering. Developed at Bell Labs and MIT, dithering was originally an approach to picture transmission. Compared to other methods, dithering is fast and accurate.

The Dithertizer II was designed for the Apple computer by David K. Hudson, a researcher at MIT. Design goals were high accuracy, fast scanning, maximum reliability and an economical price.

High Quality Images

The resolution is of the Dithertizer is the maximum the Apple can handle in the high-resolution mode, i.e., 280 x 192 (53,760) pixels.

To produce an image, a video camera is focused on the subject. Peripherals Plus furnishes a Sanyo VC161OX camera, a laboratory/industrial unit with an f 1.6 lens. This camera has a focus range of 18" (for extreme close ups) to infinity (for distant subjects).

The camera scans an entire frame in 1/60th of a second. Two frames are scanned, of course, in 1/30th of a second. By adjusting the blackness control (with Paddle 0) to any one of 255 levels you can determine the threshold of gray between the two frames.

A 1/30th second, two-frame scan has two levels of gray and produces a high-contrast but quite recognizable image.

Pictures or Contours

Using the "Contour" software routines and contrast control (Paddle 1), it is possible to subtract one image from another. If the blackness thresholds of the two images are close, say 125 and 127, the resulting image will show just the outlines or highlights of an object.

Another possibility is to reduce the contrast to zero which results in a nearly blank screen except for movement in the area scanned. This type of movement detector is much faster (1/30th second) and more precise than other much more expensve systems. It is currently being used to detect and record movement of laboratory animals. It is also used in security installations.

The "Dithering" software routines use the contrast control to divide an image into gray tones. As mentioned above, two levels (usually white and black) result in a high contrast image. Four gray levels provide additional definition while sixteen levels produce a highly detailed image in just over 1/4th of a second. Extremely high detail is possible using the highest 64-gray level setting. At this level, an image is produced in 64/60ths of a second or just over one second. The quality of this image is close to that of a halftone photograph found in a newspaper or magazine.

Using Dithered Images

What can one do with a dithered image? Upon completion it can be stored automatically in either page 1 or 2 of the high-resolution graphics area of the Apple. Hence, it can be printed out on practically any printer. To print it on an Apple Silentype printer or equivalent requires no additional software.

To take advantage of the automatic print routines in the Dithertizer itself does require additional software tailored to a specific printer. Software packages are available at $44.95 each for the following printers: IDS 440, 445, 460, and 560; IP225; Anadex DP9500 and DP9501; Spinwriter 5510 and 5520.

Individual images or series of images may also be incorporated in other programs in the same way that other hi-res graphics are used. Using VersaWriter software, for example, text may be added to images. An image may be shown on the screen while a disk is loading or while the computer is completing a time-consuming calculation in another program.

With the proper software, the Dithertizer can be used to perform image enhancement, to identify features, detect motion, track a moving target or create a detailed picture for display. The possibilities are limited only by your imagination.

Quality Construction

The dithertizer is manufactured to exacting specifications by Computer Station. It consists of the Dithertizer II board which plugs into Slot 7 in the Apple II, a cable which connects between the Dithertizer and motherboard and a 10 foot cable to the camera. The system requires a 48K Apple disk system.

The software package consists of three routines on disk: "Dither" to build a gray scale picture, "Contour"to produce an edge scan using image subtraction, and "Dscan" to store a binary image in either page 1 or 2 of the high-resolution graphics area.

Peripherals Plus also includes a Sanyo VC161OX video camera with external horizontal and vertical sync input.

The components of the packge—hardware, software and camera—are warranteed by the manufacturers against defects in material and workmanship for 90 days. In addition, Peripherals Plus guarantees that if you are not completely satisfied you may return the system for a prompt and courteous refund.

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The entire Dithertizer system consisting of the Dithertizer board, Sanyo camera, cables and software costs only $650 plus $6 shipping and handling in the continental United States. Customers in other loctions should write for shipping rates. Price for the board and software alone is $300 while the camera alone is $410. To order your system, send payment or Visa, MasterCard or American Express card number and expiration date to the adress below. Credit card customers may also call orders to our toll-free number.

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CIRCLE 239 ON READER SERVICE CARD

Stephen B. Gray

Responses to TRS-80 Challenge no. 2 -Star Within a Circle

A long time ago, back in the May 1980 *Creative* (p. 148), the second TRS-80 software challenge was put to you readers. Here's a reprint of that challenge:

Software Challenge #2 — Star Within a Circle

Quite a variety of responses to the first software challenge (September 1979, p 190) was received, and five are described in this issue.

Now it's time for a second challenge: write a program that puts a circle with a diameter of 2 to 5 inches anywhere on the TRS-80 screen, and then puts a five-pointed star within that circle, just touching it.

Just as several astute readers came up with some clever variations on the first challenge, others will see possibilities in the second challenge that lie beyond the single sentence.

Although many solutions were received in response to the first software challenge, several times as many people responded to the second. Over a third consisted only of a listing; I'd neglected to ask for a "short cassette of the program," as I had in the first challenge. The result was hours of typing, which led to several severe attacks of lassitude. Hence the lateness of this report.

Range of Entries

The entries ranged all the way from a Westchester computer consultant who wrote, "I used Applesoft. So sue me!" to many who went far beyond the original bounds of the challenge.

A very few sent in the minimum program. Others exercised vast amounts of imagination, and sent in programs that rotate the star by an input amount, draw the star within a circle or an ellipse, draw a star with as many points as desired, draw the star at the same time as the circle, draw any polygon (or a star) within the circle, draw white on black or vice versa, draw circles around the star points, or add shading to the star.

Nine Runners-Up

Before we get to the top three entries, nine other programs with highly ingenious features deserve mention.

Incidentally, the quality of programs submitted was very high. There was only one program I couldn't make work. Although the listing was beautifully indented, it kept giving errors. A DIM was added here and a GOSUB corrected there, among many other fixes, but the program still had such problems that I put it aside and went on to programs that worked.

One other program had a problem I couldn't fix right away, but all the others either ran perfectly or could be fixed quickly, which means that *Creative* has many fine programmers among its readers.

Ron Casterson

A program that draws stars with 3 to 11 points was sent by Ron Casterson (Livermore, CA). It uses wraparound, so that if you specify 0,0 as the center of the circle, a quarter of the circle will be displayed in each corner of the screen. As Casterson notes, "There is a choice of 3, 5, 7, 9 or 11 points for the star."

Wallace P. Havenhill

The program from Wallace P. Havenhill (Cleveland Heights, OH) isn't interactive; it draws a circle of random diameter at a random location, draws in a five-pointed star, clears the screen, and repeats the process elsewhere on the screen, all automatically.

Vincent M. Hietala

One of the very shortest programs is from Vincent M. Hietala (Embaras, MN), with only 35 active statements. It asks for the length of the horizontal and vertical axes, then gives you the limits of where you can put the center of the circle or ellipse in which the circle will be drawn, such as

```
30 < X < 98, 20 < Y < 28
```

John L. Thomas

The first display in the program from John L. Thomas (Bolingbrook, IL) is a full screen of information telling the user what to do, and describes the use of "skip values," which "determine the linking of

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Aspen Software programs are professional quality, reliable software tools developed for the TRS-80 and CP/M by a Ph.D. in Computer Science. All software is protected by Aspen Software's low cost upgrade privilege for new versions. Other tools include:

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— RATFOR, a structured language preprocessor for Fortran developed at Bell Labs. Aspen Software Ratfor is one of the best versions available, and the only one with a pretty printer option. Totally compatible with Microsoft F80. Includes several extensions, including "case", "string", and conditional compilation. User's manual contains all information needed to learn and write Ratfor programs. Requires FORTRAN.

— PP-RATFOR, a pretty printer. Automatically formats and indents Aspen Software Ratfor source programs. An essential program development tool.

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Grammatik	$59.00(32k1d)	$99.00	$59.00(32k1d)	$149.00	$8.00
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CIRCLE 116 ON READER SERVICE CARD

the touch points," which are the points at which the inscribed figure touches the circle. "A skip of 1 will link adjacent points; a skip of 2 will link every other point."

Subsequent displays ask for radius, step size, number of points, skip value, and coordinates of the center. This is one of the very few programs that can draw stars with an even number of points.

Thomas Bartkus

Although the entry from Thomas Bartkus (Rutherford, NJ) is straightforward, it's one of the very few that offer default values if you don't choose to select the location of center (63,23), diameter of circle (6.5), and rotation angle (0 degrees).

Thus you can draw the circle with only three depressions of the ENTER key, after which the program draws in the five-pointed star. Had the program offered options on the drawing of the star, such as number of points, it would have been a winner.

Bartkus has an ingenious feature: "The 'off-screen print routine' at the end recovers from an error caused by trying to set points off-screen. While doing so, it flashes the pixel at the center of the circle to indicate what is happening and that the program is not hung up. This allows the drawing of a figure that is too large or positioned so that it cannot be entirely contained by the screen."

Bartkus, by the way, won the first TRS-80 Software Challenge (his winning program was shown in May 1980, p. 162).

Dan Kegel

The first display in the program from Dan Kegel (Bellevue, WA) asks

```
WOULD YOU LIKE ME TO DRAW.....
     (1) QUICK AND DIRTY, OR
     (2) SLOW AND CAREFUL?
```

which is a nice touch, along with asking if you

```
WANT TO
(1) SEE JUST THE PENTAGRAM, OR
(2) CHOOSE YOUR OWN FAMILY OF FIGURES?
```

which are both fine interactive features.

If you choose your own family of figures, you're asked if you

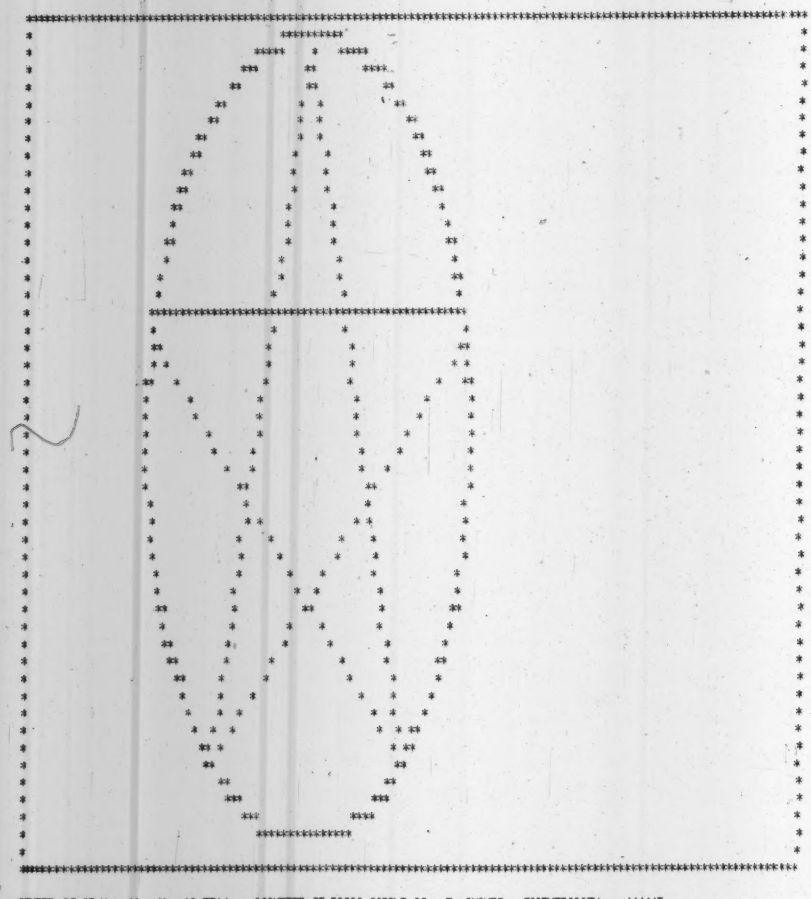
```
WANT TO  (1) LOOK AT JUST ONE FAMILY
              OF FIGURES, OR
(2) LOOK THROUGH ALL FIGURES NONSTOP?
```

and if you choose the latter, and pick six as the number of "sides you want the initial figure to have," you get first a "6-gram, order 2," then a "6-gon," followed by a "7-gram, order 3," "7-gram, order 2," "7-gon," "8-gram, order 3," etc.

This program is the only one that draws the stars from the center out; it also includes a hard-copy routine.

Kegel's program would be a winner if there weren't several others that are just a little more versatile. That's a very subjective opinion, of course, and you might pick this one for the winners' circle.

Figure 1. Ellipse and star, from program by Daniel E. Nickell, the only one to list relevant data on the printout.



```
CENTER IS AT X = 44 , Y = 10.5714 .  DIAMETER OF BASIC CIRCLE IS = 3  INCHES.  ECCENTRICITY = .444445
```

Daniel B. Nickell

The program from Daniel B. Nickell (Laurel, MD) asks for diameter, how far from the left side of the screen shall the center be, how far from the top of the screen shall the center be, and will a printer be used. If you pick a dimension or location beyond the limits, you're told what the limits are, rather than being given the limits in the first place, which is the computer's way of seeing if you're awake.

After the circle and star are drawn, the display asks if you want to

```
(R)EVIEW AGAIN, (E)CCENTRICITY
     ADJUST, (S)TOP
```

and if you press E, you're asked to enter the vertical (VE) and horizontal (HE) eccentricity, and if a printer will be used. If you select the right amount of eccentricity, an ellipse is drawn, the star is inscribed within it, and then the figure is printed out (Figure 1).

Two problems: if you select an eccentricity beyond the display-area limits, you get an FC error; and the output routine is for a printer with at least 130 columns. If you use a printer with less column capacity, you get a printout consisting of an overlapping of the two halves of the figure.

The eccentricity figure at the bottom of the printout is HE/VE. Nickell notes "The program does not try to make the printed version of the circle circular. Thought we'd leave that to someone needing a challenge."

OSI TRS-80 COLOR-80 OSI

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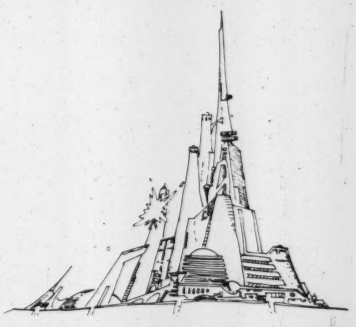

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CIRCLE 102 ON READER SERVICE CARD

OSI COLOR-80

Challenge, continued...

James Jones

A remarkable handwritten program was sent in by James Jones (Lisle, IL), who doesn't "have access to a TRS-80." What's remarkable is not so much what the program does, but that it works as written, because Jones apparently never ran it.

The Jones program asks for a radius between 2 and 5, an integer N greater than 2, and a number S between 1 and N, "relatively prime to N."

That could weed out the non-mathematicians right away, except that if you don't guess correctly, the question keeps repeating until you select a correct S, a very nice touch.

Depending upon your choice of the three variables, you get a variety of figures, which are drawn in a unique fashion: the star is drawn at the same time as the circle.

Integer N turns out to be the number of points in the star. If S is odd, a polygon is drawn; if even, a star; Jones calls S the "step size," which is the same as John Thomas's "skip value."

So an N/S of 5/1 results in a 5-gon (pentagon), while 5/2 produces a 5-gram (pentagram) or five-pointed star (Figure 2). An N/S of 6/5 provides a hexagon in a circle, with the two drawn in opposite directions, one clockwise, the other counterclockwise, using polar coordinates. Using 6/1 draws the same hexagon, but in the same direction as the circle. The catch here is that with an N of 6, the only S values acceptable to the program are 1 or 5, so it can't draw a six-pointed star, or any other star with an even number of points.

An interesting touch: as the sides of the star or polygon reach their maximum length while being drawn, they meet the circle-drawing pixel as it comes around the bend.

Jones gets the accompanying-notes prize for an extended explanation of how his program operates, preceded by a generalized examination of the problem. Among his notes are:

"One *could* draw the circle and *then* draw the polygram, but that seemed less fun than letting them grow together. The line segment meets the arc at the far end just as the arc gets there."

The notes lead up to the use of rotation matrices to draw the segments after the first one. One further note:

"Your prize should go to the person whose program is hardest to lead into roundoff error. That is *not* this program."

Figure 2. The legend beneath James Jones's star, which has an N/S of 5/2, is a "moving sign" that asks you to "hit a key to start again."

John Zvonar

Just outside the winners' circle is the entry by John Zvonar (Austin, TX). His opening display provides four options:

```
INPUT THE OPTION # AS LISTED BELOW
OPTION #1 SINGLE CIRCLE & STAR
OPTION #2 FIVE CIRCLES AND STARS
          ON POINTS
OPTION #3 FIVE CIRCLES ON POINTS
OPTION #4 RND CIRCLES
```

Select any of the four, and you're asked if you want black on white or not, then the radius, step size, and center coordinates. Option 2 provides a star in a circle, plus a circle around each of the five points, and a star within each of those five circles. Option 3 leaves out the five extra stars, and option 4 draws stars in circles of random size at random locations, one after another.

For black on white, Zvonar first paints the screen white, then draws the figure with black pixels. Figure 3 results from Option 3, with circles on the points, black on white, 4.7" circle, 0.1" increments, centered on the screen. However, as the photo (Figure 3) shows, the star sides are not equal in length, which is one of the few things that keeps this entry outside the winners' circle.

Zvonar sent solutions in both Level II and Level III Basic.

Three Winners

Three entries have such a variety of outstanding and different features that there's no way to choose only one of them as the winner. Look over the three, and pick your own.

Douglas Smyth

The first of the three winners is Douglas Smyth (San Simeon, CA), whose program asks for the radius of the circle in inches, a center point (whose given limits derive from the chosen radius), the number of vertices in the star (the number must be odd), degrees of clockwise rotation, whether there is to be shading in the star or not, and whether the figure is to be normal or reversed (black star in a white circle).

While the circle is being drawn, the legend in the lower right corner says

```
DRAWING
 CIRCLE
```

and later, when the star segments are being drawn, a number indicates which segment is involved:

```
DRAWING
 SEG.
  1
```

When the drawing is finished, the corner legend says:

```
HIT ANY
KEY TO
RESTART
```

Figure 4 shows a Smyth circle of 3" radius, centered at 63,23, with a star of 15 vertices, 0 degrees rotation, shading in the star, normal (white on black). Although this figure looks nice, it takes forever to draw on the TRS-80.

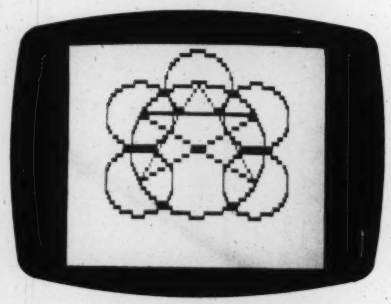

Figure 3. John Zvonar's program draws circles around the points of the star, and will also draw stars within those circumferential circles, as well as draw black on white.

Figure 4. The sunburst star by Douglas Smyth has 15 vertices and is shaded in. It could optionally have been drawn black on white.

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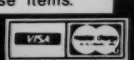

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Figure 5. Program listing by Douglas Smyth. Note line 670.

```
40 REM xxxxxxxxxxxxxxxxxxxxxxxxxxxx
50 REM xx SOFTWARE CHALLENGE #2 xx
60 REM xx STAR WITHIN A CIRCLE  xx
70 REM xx DOUG SMYTHE   6/30/80 xx
80 REM xxxxxxxxxxxxxxxxxxxxxxxxxxxx
90 'INITIALIZE PARAMETERS
99 '
100 DEFINT F-H,N-S,U-Y: FL=0: DIM X1(1),Y1(1), X2(1),Y2(1), DX(1),DY(1),
    M(1), X (1),Y(1)
110 CLS: INPUT "RADIUS (IN INCHES) ";R!
120 DX=63-15.9*R!: DY=23-6.8*R!: IF DX<0 OR DY<0 THEN 180
130 PRINT "CENTER POINT (X=";MID$(STR$(INT(63-DX+.5)),2);"-";MID$(STR$(INT
    (64+DX +.5)),2);
140 PRINT ", Y=";MID$(STR$(INT(23-DY+.5)),2);"-";MID$(STR$(INT
    (24+DY+.5)),2);") ";
150 INPUT CX,CY
160 R1=INT(R!*15.9+.5): R0=INT(R!*6.8+.5)
170 IF CX-R1>=0 AND CX+R1<=126 AND CY-R0>=0 AND CY+R0<=47 THEN 190
180 PRINT "* CIRCLE WON'T FIT ON SCREEN *": FOR X=1 TO 1200: NEXT: GOTO 110
190 INPUT "NUMBER OF VERTICES IN STAR";N: N=INT(N)
200 IF N<=3 OR N/2=INT(N/2) THEN 210  ELSE 220
210 PRINT"  * ERROR *  MUST BE ODD INTEGER GREATER THAN 3": PRINT "PLEASE
    RE-ENTER ";: GOTO 190
220 INPUT "DEGREES OF CLOCKWISE ROTATION";RF
230 IF RF>=180./N OR RF<= -180./N THEN PRINT "TOO MUCH... RE-ENTER ";:
    GOTO 220
240 INPUT "SHADE IN STAR (Y/N) ";F$
250 IF LEFT$(F$,1)="Y" THEN F=1 ELSE F=0
260 INPUT "REVERSE OR NORMAL";F$: IF LEFT$(F$,1)="R" THEN RV=1 ELSE RV=0
265 IF CX<64 THEN SP=56 ELSE SP=0
266 IF CY<24 THEN SP=SP+832
269 '
270 CLS: PRINT @SP, "DRAWING";: PRINT @SP+64, "CIRCLE";
275 FOR A=0 TO 6.3 STEP .06/R!
280  I=CX+R1*SIN(A): J=CY-R0*COS(A)
290  SET(I,J): IF RV=0 SET(I+1,J)
299 '
300 IF RV=1 THEN X1(1)=CX: Y1(1)=CY: X2(1)=I: Y2(1)=J: FL=1: GOSUB 390
310 NEXT
320 B7=180/3.141593: A=CX+SIN(RF/B7)*R1: B=CY-COS(RF/B7)*R0: Z1=180-180
    ./N: FL=0  : RV=1-RV
329 '
330 FOR I=1 TO N
340 PRINT @SP, "DRAWING";: PRINT @SP+64, " SEG. ";: PRINT @SP+129, I;
350 T=I*Z1+RF
360  C=CX+SIN(T/B7)*R1: D=CY-COS(T/B7)*R0: FL=0
370  X1(0)=A: Y1(0)=B: X2(0)=C: Y2(0)=D
380 '       SAVE PARAM. IN ARRAY FOR RE-ENTRY
390  DY(FL)=Y1(FL)-Y2(FL): DX(FL)=X1(FL)-X2(FL): IF DX(FL)=0 THEN 550
400 '       CALCULATE DIFF OF "X" AND DIFF OF "Y". IF VERTICAL, JUMP
410  M(FL)=DY(FL)/CSNG(DX(FL)): IF ABS(M(FL))>1 THEN 550
420 '       JUMP IF MORE VERTICAL (SLOPE>1)
430  FOR X=X1(FL) TO X2(FL) STEP -SGN(DX(FL)): X(FL)=X
440 '       LOOP FOR EACH "X"   MUST SAVE LOOPING VARIABLE TO RESTORE LATER
450   Y(FL)=M(FL)*(X(FL)-X1(FL))+Y1(FL)+.5
460 '       CALCULATE "Y"
470   IF RV=0 RESET (X(FL),Y(FL)) ELSE SET (X(FL),Y(FL))
480   IF FL=1 OR F=0 THEN 530
490   X1(1)=CX: Y1(1)=CY: X2(1)=X(FL): Y2(1)=Y(FL): FL=1: GOSUB 390 : FL=0
500 '       UPDATE THE ENDPTS. TO (FROM) CENTER TO PT. WE JUST DREW
510 '       SET FLAG (FL) TO SAY WE'RE RE-ENTERING SUBROUTINE
520   X=X(FL)
530  NEXT: GOTO 630
540 '       (550-620) IS SAME AS (410-530) ABOVE
550  M(FL)=DX(FL)/DY(FL)
560  FOR Y=Y1(FL) TO Y2(FL) STEP -(SGN(DY(FL))): Y(FL)=Y
570   X(FL)=M(FL)*(Y(FL)-Y1(FL))+X1(FL)+.5
580   IF RV=0 RESET (X(FL),Y(FL)) ELSE SET (X(FL),Y(FL))
590   IF FL=1 OR F=0 THEN 620
600   X1(1)=CX: Y1(1)=CY: X2(1)=X(FL): Y2(1)=Y(FL): FL=1: GOSUB 390 : FL=0
610   Y=Y(FL)
620  NEXT
630  IF FL=1 THEN RETURN '    IF DRAWING MINOR LINE, RETURN TO MAJOR
640 A=C: B=D: NEXT I
650 PRINT @SP, "HIT ANY";: PRINT @SP+64, "KEY TO";: PRINT
    @SP+128, "RESTART";
660 IF INKEY$>"" THEN 110  ELSE 660
670 REM xx NOTE: AUTHOR OF PROGRAM IS ONLY 15 YEARS OLD (!!)
```

In his notes, Smyth "would like to ... thank those Radio Shack managers and others from whom I solicited computer time, since I can't afford one myself." As the last line of the program (Figure 5) shows, Smyth was "only 15 years old" when he wrote it.

Smyth was one of the very few to send in line-by-line comments (Figure 6).

Ian Taylor and Jonathan Mark

The second of the three winners is the team of Ian Taylor and Jonathan Mark (Cambridge, MA), who sent in a machine-language routine "which only displays the required circle and star," and also a Basic program "which goes somewhat beyond the limits of the challenge."

The TRS-80 used didn't have a printer, so they "got a typed copy by copying the program off the screen, entering it into another computer (a DEC System-20), and typing it out."

The first display asks if you want a star (four to ten vertices), a regular polygon (three to ten vertices) or a "self-made figure." If you take the first or second choice, you're asked if you want a second figure; you can display one or two figures at the same time, two stars or two polygons or one of each, with or without the circumscribed circle (Figure 7).

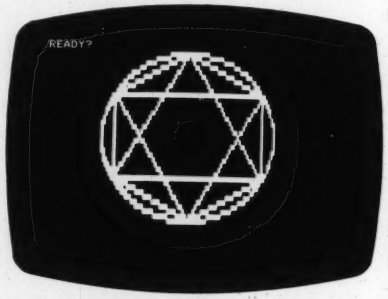

Figure 7. Unique three-layer display by Ian Taylor and Jonathan Mark, displaying star with odd number of vertices, and circumscribed polygon and circle.

The program will draw a star within a circle, or a polygon within a circle, or a star within a polygon, or one star over another. This is one of the very few programs that will draw stars or polygons with an even number of sides, and the only one I remember that will draw an eight-sided polygon around a six-pointed star, for example.

You do not select the size or location of the figure; the program draws a figure about five inches in diameter in the center of the screen.

The idea of a self-made figure is that touch of genius that often separates winners from losers. Ask for item three on the first display, and you get

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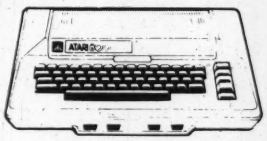

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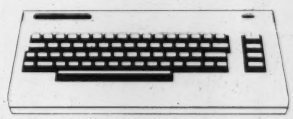

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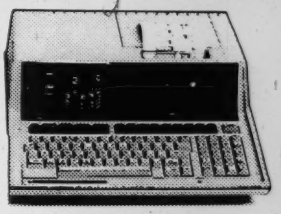

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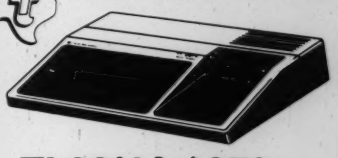

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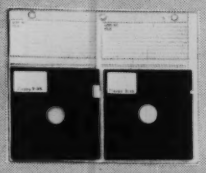

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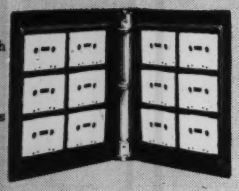

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CIRCLE 299 ON READER SERVICE CARD

Challenge, continued...

```
ENTER THE ANGLE MEASURE OF THE POINTS, IN ORDER OF
CONNECTION, ACCORDING TO THE FOLLOWING CHART:
    180
     :
     :          FOR OTHER POSITIONS, JUST GIVE AN
270 -:- 90    INTERMEDIATE NUMBER. THUS, THE UPPER
     :        RIGHT HAND CORNER IS 135.
     0
TO STOP AT THE POINT YOU JUST ENTERED (NOT CONNECT
IT TO THE NEXT POINT) ENTER A -2.
WHEN DONE, ENTER A -1.
ENTER NO MORE THAN 30 POINTS, PLEASE.
```

Figure 6. Program comments by Douglas Smyth. Note the comment on line 670.

```
-------------------------------------------------------------
                      INITIALIZE
100  DEFINT where allowable (for speed), put FL at top of
     variable list, dimension 9 arrays to use 0 and 1
     subscripts.
-------------------------------------------------------------
                         INPUT
110  Enter radius (R!).
120  Check for legal radius.
130-140  Print X-Y ranges for center point (Note:
     MID$(STR$(INT(numeric exp.)),2) returns a string
     representation of # with no leading or trailing
     blanks.
150-170  Input center (CX,CY), check if R1=radius in blocks
     horizontally, R0=radius in blocks vertically.
180  Indicate circle is too big.
190-210  Enter # of vertices (N), inform if illegal.
220  Enter rotation factor (RF) in degrees.
230  If it tilts past another vertex (in normal position),
     ask for re-enter.
240-250  Shade in?  F=1 for yes, 0 for no.
260  Reverse image (black on white)? RV=1 if yes, 0 if no.
265-266  SP=screen position to write messages at.
-------------------------------------------------------------
                        CIRCLE
270  CLS, tell human we're drawing a circle.
275   Start loop. Step size for circle = 0.6/radius, or
     .06/R!
280  Calculate X,Y co-ords of point (in I,J).
290  Turn it on.  If not reverse, SET the one on its right,
     too.
300  If reverse,  draw  line  from center pt. to point of
     circle just drawn.
310  NEXT A
-------------------------------------------------------------
                    SET-UP FOR STAR
320   B7=degrees-to-radians conversion factor. Calculate
     first pt. (A,B) Z1=# of degrees to rotate each loop,
     reset FLag, reverse the reverse (star must be opposite
     shade of that of the circle).
330  Loop once for each segment of star.
340  Indicate in corner.
350  T=total no. of degrees rotated so far.
360  C,D =  co-ordinates of other-end pt.,  reset FLag again
     (each loop).
370  Retain original co-ords.
-------------------------------------------------------------
390  Difference of X and Y  co-ords. If vert. (diff of X=0),
     jump to "more vertical."
410   M=slope.  If  more vertical,  go  to  "more  vertical"
     drawer.
430  Loop for each X.
450  Calculate Y.
470  SET or RESET, depending on ReVerse.
480  If fill-in  not  wanted, skip  next step. Skip  also if
     already in subroutine.
490  Save current  values,  set FLag,  draw line from center
     to most recent point.
520  Restore looping variable.
530  NEXT, skip over "vert" drawer.
550-620  Just  like 410-530,  but  Xs  and Ys are exchanged,
     for verticality.
630  If this was a subroutine, RETURN.
-------------------------------------------------------------
640  Next "start" point = previous "end" point.
-------------------------------------------------------------
650  All done, so label.
660  Wait for key to be struck, then re-start.
670  I love to brag...
-------------------------------------------------------------
```

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CIRCLE 173 ON READER SERVICE CARD

Challenge, continued...

This permits drawing stars or polygons with equal or irregular sides. You can also create stars with as many points as you wish, although they begin to look messy beyond a dozen vertices, because of the limited resolution of the TRS-80 raster-scan graphics.

In the listing (Figure 8), lines 90, 300 and 1000 have been spaced to minimize line length; when entering these lines, delete the lengthy spacings. Note the unique use of a label at *both* ends of the listings, for rapid identification just in case the listing, which is two pages long, is cut in two.

In their covering letter, the authors write, "The program is quite simple; it fills an array (P) with the angle measure of each of the vertices (in polar coordinates), and then connects them. It stops when it finds -1 in the point array. When it finds a -2, it doesn't connect the subsequent point with the last one. This is necessary for stars with an even number of vertices."

Note that the program automatically selects "skip values" so that the angle at the star vertices is minimum.

You may find a small bug or two, depending upon what figure you ask for. The detecting and removal of these bugs is, as the textbooks put it, "left as an exercise for the student."

John Craig

The third of the three winners is John Craig (Anaconda, MT). (No, this isn't the John Craig who was the editor of *Creative* after I was; it's the John Craig who submitted one of the best responses to the first TRS-80 Software Challenge.)

The Craig program has several unique features. The first display flickers a rectangle alternately in front of CIRCLE and ELLIPSE, and asks you to

```
PRESS <ENTER> TO STOP
FLICKER NEAR YOUR CHOICE
```

The next display asks if you want to stay in the 2 to 5" diameter range. If you do, a slowly lengthening line, approaching a maximum of 2 1/4," is shown in the middle of the screen; you press ENTER when the radius is "what you want."

Figure 8. Program listing by Ian Taylor and Jonathan Mark. Note labels at both ends.

```
1 REM ********************************************************
2 REM ***    SOLUTION TO TRS-80 SOFTWARE CHALLENGE # 2     ***
3 REM ***                       BY                         ***
4 REM ***          IAN TAYLOR AND JONATHAN MARK             ***
5 REM ***               CAMBRIDGE, MA.                      ***
6 REM ********************************************************
9 DIM P(30),P1(30)
10 CLS:GOSUB 300
15 INPUT "DO YOU WANT THE CIRCLE DISPLAYED";A$
16 CLS:IF LEFT$(A$,1)="N" THEN 70
19 REM *** DISPLAY CIRCLE
20 FOR A=0 TO 6.28 STEP .02
30 B=42*SIN(A)+60.5
40 C=18*COS(A)+20.5
50 SET (B,C)
60 NEXT A
69 REM *** DISPLAY FIGURE (POINTS ARE IN P ARRAY)
70 M=1:FR=P(1)
80 M=M+1:T0=P(M)
90 IF T0=-1 THEN PRINT@ 0, "READY";:INPUT A$:
   IF A$="STOP" THEN CLS:END ELSE 10
95 IF T0=-2 THEN M=M+1:FR=P(M):GOTO 80
97 K=FR*.01745329:K1=T0*.01745329
100 Y1=18*COS(K)
110 X1=42*SIN(K)
120 Y2=18*COS(K1)
130 X2=42*SIN(K1)
150 GOSUB 400
190 FR=T0
200 GOTO 80
210 END
299 REM *** WHAT FIGURE DO THEY WANT?
300 PRINT "DO YOU WANT:":PRINT ,"1) A STAR":
    PRINT ,"2) A REGULAR POLYGON":PRINT ,
    "3) A SELF-MADE FIGURE"
310 INPUT I
320 GOSUB 500:RETURN
399 REM *** DRAW LINE FROM (X1,Y1) TO (X2,Y2)
400 IF ABS(Y2-Y1)>ABS(X2-X1) THEN 460
410 Q=Y1
420 FOR X=X1 TO X2 STEP SGN(X2-X1)
430 SET (X+60.5,Q+20.5)
440 Q=Q+(Y2-Y1)/ABS(X2-X1)
450 NEXT X:RETURN
460 Q=X1
470 FOR Y=Y1 TO Y2 STEP SGN(Y2-Y1)
480 SET (Q+60.5,Y+20.5)
485 Q=Q+(X2-X1)/ABS(Y2-Y1)
490 NEXT Y:RETURN
499 REM *** FILL P ARRAY
500 ON I GOTO 600,700,800
599 REM *** USER WANTS A STAR
600 INPUT "HOW MANY VERTICES (4-10)";V
610 IF V<4 OR V>10 THEN 600
620 IF V/2=INT(V/2) THEN 660
630 FOR I=1 TO V
640 P(I)=(I-1)*(360/V)*INT(V/2)+180
650 NEXT I:P(V+1)=180:P(V+2)=-1:GOTO 1000
660 FOR I=0 TO 1:FOR J=1 TO V/2
670 P(J-(I=1)*(V/2+2))=(2*J-I)*(360/V)+180
680 NEXT J,I:P(V/2+1)=P(1):P(V/2+2)=-2
690 P(V+3)=P(V/2+3):P(V+4)=-1:GOTO 1000
699 REM *** REGULAR POLYGON
700 INPUT "HOW MANY VERTICES (3-10)";V
705 IF V<3 OR V>10 THEN 700
710 FOR I=0 TO V-1
720 P(I+1)=(360/V)*I+180
730 NEXT I:P(V+1)=180:P(V+2)=-1:GOTO 1000
799 REM *** USER CREATED SHAPE
800 PRINT "ENTER THE ANGLE MEASURE OF THE POINTS, IN ORDER OF"
810 PRINT "CONNECTION, ACCORDING TO THE FOLLOWING CHART:"
820 PRINT "     180"
830 PRINT "      :          FOR OTHER POSITIONS, JUST GIVE AN"
840 PRINT "270 -:- 90    INTERMEDIATE NUMBER. THUS, THE UPPER"
850 PRINT "      :        RIGHT HAND CORNER IS 135."
860 PRINT "      0"
870 PRINT "TO STOP AT THE POINT YOU JUST ENTERED (NOT CONNECT"
880 PRINT "IT TO THE NEXT POINT) ENTER A -2."
890 PRINT "WHEN DONE, ENTER A -1."
895 PRINT "ENTER NO MORE THAN 30 POINTS, PLEASE."
900 I=0
910 I=I+1:INPUT P(I)
920 IF P(I)=-1 THEN RETURN
930 IF I=29 THEN PRINT "YOU ONLY HAVE 1 POINT LEFT."
940 IF I=30 THEN PRINT "THAT'S ALL, SORRY.":P(I)=-1:RETURN
950 GOTO 910
999 REM *** SECOND FIGURE?
1000 IF F9=1 THEN RETURN ELSE INPUT "DO YOU WANT
     A SECOND FIGURE";A$
1010 IF LEFT$(A$,1)="N" THEN RETURN
1020 FOR I=1 TO 20
1030 IF P(I)=-1 THEN M=I:GOTO 1060
1040 P1(I)=P(I)
1050 NEXT I
1060 F9=1
1070 GOSUB 300
1075 F9=0
1080 FOR I=1 TO 30-M
1090 P(I+M)=P(I)
1100 NEXT I
1110 FOR I=1 TO M-1
1120 P(I)=P1(I)
1130 NEXT I
1140 P(M)=-2
1150 RETURN
1200 '********************************************************
1210 '***    SOLUTION TO TRS-80 SOFTWARE CHALLENGE # 2     ***
1220 '***                       BY                         ***
1230 '***          IAN TAYLOR AND JONATHAN MARK             ***
1240 '***               CAMBRIDGE, MA.                      ***
1250 '********************************************************
```

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CIRCLE 137 ON READER SERVICE CARD

Challenge, continued...

If you select an ellipse, you chose both horizontal and vertical radii by the same line-length method (Figure 9).

On the other hand, if you don't want to stay within the smaller-diameter range, the display permits choosing a radius of up to 3 1/8".

Whether you select a circle or an ellipse, you then "determine a center for your figure." Just to check you out, the display asks if you "want to keep it all on the screen for sure." If you do, you select the center by pressing ENTER when a wandering pixel is in the right place, first as it moves left and right, next as it moves up and down. The limits for this display depend upon the diameter chosen, and range from a large area down to 3" by 3". You get the small display area if you "want to keep it on the screen for sure," or the full area if not. If you don't want to keep all of the star on the screen, only part of it will be drawn, in a corner or on a side; there is no wraparound.

You're asked the

```
NUMBER OF POINTS
ON THE STAR PART
```

and

```
WHAT SEPARATION DISTANCE
N DO YOUR WANT
```

If, for instance, you select six points and an N of 4, the display says

```
BUT THAT WON'T DRAW
A 6-POINTED STAR ...
LET'S TRY AGAIN.
```

and you do until you get it right. However, the only value of N the program accepts for a six-pointed star is 1 or 5, meaning that it really can't draw a six-pointed star, but only a six-sided polygon.

If you choose more than 13 points for the star, the display says

```
WHEW!  I'LL GIVE IT A TRY ...
```

After you've selected a proper value for N, the display asks what orientation you want for the star (Figure 10), by asking if you want one of the points to be at the right, bottom, left, top or some other angle. If you want a particular angle, you're asked to give it.

After the program draws the figure (Figure 11), it ends with a very clever touch: the display flashes back and forth from black-on-white to white-on-black, until you press ENTER (or any other key) to run again.

John Craig's program (Figure 12) is accompanied by an "overview" (Figure 13). Note especially his "String Machine" subroutine, lines 1340-1440, with a "short video inversion routine." He also sent this "discussion of the star part":

"At first it might be assumed that only stars with an odd number of points can be drawn. Not so! For example, by connecting every third point, an eight-pointed star may be drawn. By using a rather large ellipse, the enclosed program draws a striking figure in this manner.

Figure 9. John Craig's program simplifies choosing the radii for circles and ellipses, without the use of numbers.

Figure 10. John Craig asks what orientation to give the star; you press ENTER when the flickering cursor pauses in front of your choice.

Figure 11. John Craig's nine-pointed star in an ellipse flashes back and forth between reverse and normal.

Figure 12. John Craig's program listing, with a "String Machine" subroutine in lines 1340-1440.

```
10 CLS: PRINT TAB(17)"* * *  CHALLENGE TWO  * * *
20 PRINT: PRINT: PRINT "THIS SOLUTION BY:
30 PRINT "JOHN C. CRAIG, 710 LOCUST, ANACONDA MT. 59711
40 PRINT: PRINT: PRINT: PRINT: CLEAR777
50 PRINT "PRESS <ENTER> TO STOP FLICKER NEAR YOUR CHOICE ...
60 PRINT@780, "CIRCLE": PRINT@800, "ELLIPSE"
70 F(1)=16138: F(2)=16158: F(10)=2
80 GOSUB 1300: E=F(0): CLS: PRINT@384, "";
90 PRINT "WANT TO STAY IN THE 2 TO 5 INCH DIAMETER RANGE ? ";
100 T$=INKEY$: IF T$="" THEN 100
110 IF T$<>"Y" THEN GOTO 130
120 XM=40: XN=16: YM=17: YN=7: GOTO 140
130 XM=55: XN=1: YM=23: YN=1
140 CLS: PRINT "PRESS <ENTER> WHEN ";
150 IF E=2 THEN PRINT "HORIZONTAL 'RADIUS'";
160 IF E=1 THEN PRINT "RADIUS";
170 PRINT " IS WHAT YOU WANT ..."
180 X=64: Y=24: XR=XN
190 FOR I=64 TO 64+XN: SET(I,Y): NEXT I: SET(64+XN,Y)
200 XR=XR+1: IF XR>XM THEN XR=XN: PRINT@512, CHR$(30): GOTO 190
210 SET(X+XR,Y): FOR T=1 TO 20
220 IF INKEY$="" THEN NEXT T: GOTO 200
230 IF E=1 THEN YR=3*XR/7: GOTO 330
240 PRINT@0,CHR$(30);
250 PRINT "NOW <ENTER> FOR THE DESIRED VERTICAL 'RADIUS'..."
260 X=64: Y=24: YR=YN
270 FOR I=24 TO 24+YN: SET(X,I): NEXT I: SET(X,24+YM)
280 YR=YR+1: IF YR<YM+1 THEN 310
290 FOR T=25 TO 47: RESET(X,T): NEXT T
300 YR=YN: GOTO 270
310 SET(X,Y+YR): FOR T=1 TO 44
320 IF INKEY$="" THEN NEXT T: GOTO 280
330 FOR T=1 TO 123: NEXT T: CLS
340 PRINT "NOW WE NEED TO DETERMINE A CENTER FOR YOUR FIGURE."
350 PRINT "WANT TO KEEP IT ALL ON THE SCREEN FOR SURE ? ";
360 T$=INKEY$: IF T$="" THEN 360
370 MX= -(T$="Y"): CLS
380 PRINT " USE THE <ENTER> KEY TO STOP ME AT THE HORIZONTAL"
390 PRINT "(AND THEN THE VERTICAL) POSITION OF YOUR CHOICE ..."
400 XC=64: YC=24: XI=1: YI=0
410 XI= -SGN(XI): YI= -SGN(YI)
420 RESET(XC,YC): XC=XC+XI: YC=YC+YI: SET(XC,YC)
430 IF MX=0 THEN 460
440 SET(128-XR,48-INT(YR)): SET(128-XR,YR)
450 SET(XR,48-INT(YR)): SET(XR,YR): GOTO480
460 SET(127,47): SET(127,0)
470 SET(0,47): SET(0,0)
480 IF INKEY$<>"" THEN 570
490 IF XI=0 THEN 530
500 IF MX=1 THEN IF XC>127-XR OR XC<=XR THEN 410
```

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8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
NAME	**DESCRIPTION**	
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAPI	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
98	SALELEAS	Sale-leaseback analysis
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CIRCLE 138 ON READER SERVICE CARD

Figure 12, continued.

```
510 IF MX=0 THEN IF XC>126 OR XC<1 THEN 410
520 GOTO 550
530 IF MX=1 THEN IF YC>47-INT(YR) OR YC<=YR THEN 410
540 IF MX=0 THEN IF YC>46 OR YC<1 THEN 410
550 FOR T=1 TO -3*(XI<>0)-19*(YI<>0)
560 NEXT T: GOTO 420
570 IF YI=0 THEN YI=1: XI=0: GOTO 420
580 FOR T=1 TO 333: NEXT T: CLS
590 INPUT "NUMBER OF POINTS ON THE STAR PART"; P
600 IF P=INT(P) AND P>1 THEN 630
610 PRINT "PLEASE ENTER A POSITIVE INTEGER GREATER THAN 1"
620 PRINT "YOU KNOW ... 2,3,4,5,6  ETC.": PRINT: GOTO 590
630 IF P<13 THEN 660
640 PRINT "WHEW !    I'LL GIVE IT A TRY ..."
650 FOR T=1 TO 777: NEXT T
660 CLS: PRINT "A STAR IS DRAWN BY CONNECTING POINTS ";
670 PRINT "SEPARATED N POINTS"
680 PRINT "FROM EACH OTHER ...": PRINT
690 INPUT "WHAT SEPARATION DISTANCE N DO YOU WANT"; PS
700 IF PS>P THEN PS=PS-P: GOTO 700
710 IF PS<0 THEN PS=PS+P: GOTO 710
720 M=0: N=0
730 M=M+PS+P*(M+PS>=P): N=N+1
740 IF M>P THEN 790
750 IF M>0 THEN 730
760 IF M<P THEN 790
770 PRINT: PRINT "THAT SOUNDS OK TO ME ..."
780 FOR T=1 TO 555: NEXT T: GOTO 820
790 PRINT "BUT THAT WON'T DRAW A"P"POINTED STAR ..."
800 PRINT "LET'S TRY AGAIN."
810 FOR T=1 TO 777: NEXT T: CLS: GOTO 590
820 CLS: PRINT "USING <ENTER> TO CHOOSE, LIKE BEFORE ..."
830 PRINT "WHERE DO YOU WANT ONE POINT OF THE 'STAR' TO BE ?"
840 PRINT@270, "RIGHT"
850 PRINT@334, "BOTTOM"
860 PRINT@398, "LEFT"
870 PRINT@462, "TOP"
880 PRINT@526, "OTHER ANGLE"
890 F(1)=15627: F(2)=15691: F(3)=15755: F(4)=15819
900 F(5)=15883: F(10)=5: GOSUB 1300
910 PA=(F(0)-1)*3.141593/2
920 IF F(0)<5 THEN 1010
930 F(0)=0: CLS
940 PRINT "THEN WHAT ANGLE DO YOU WANT ?"
950 PRINT "(0=RIGHT 90=STRAIGHT UP  ETC.)
960 PRINT@350, "";: INPUT PA
970 IF PA>360 THEN PA=PA-360: GOTO 970
980 IF PA<0 THEN PA=PA+360: GOTO 980
990 PA=360-PA
1000 PA=PA*3.141593/180
1010 CLS: PRINT@533, "OK ... HERE WE GO !!!"
1020 FOR T=1 TO 555: NEXT T
1030 ST=7*YR/3: IF XR>ST THEN ST=XR
1040 CLS: FOR T=0 TO 6.28319 STEP 1/ST
1050 XS=XR*COS(T)+XC: YS=YR*SIN(T)+YC
1060 IF XS<0 OR XS>=128 THEN 1090
1070 IF YS<0 OR YS>=48 THEN 1090
1080 SET(XS,YS)
1090 NEXT T: T2=PA: DA=3.141593*PS*2/P
1100 X2=XR*COS(T2)+XC
1110 Y2=YR*SIN(T2)+YC
1120 FOR I=1 TO P: T1=T2: T2=T1+DA
1130 X1=X2: Y1=Y2
1140 X2=XR*COS(T2)+XC
1150 Y2=YR*SIN(T2)+YC
1160 GOSUB 1170: NEXT I: GOTO 1340
1170 IF ABS(Y2-Y1)>ABS(X2-X1) THEN 1240
1180 FOR X=X1 TO X2 STEP 1+2*(X2<X1)
1190 YS=(Y2-Y1)*(X-X1)/(X2-X1)+Y1+.5
1200 IF YS<0 OR YS>=48 THEN 1230
1210 IF X<0 OR X>=128 THEN 1230
1220 SET(X,YS)
1230 NEXT X: RETURN
1240 FOR Y=Y1 TO Y2 STEP 1+2*(Y2<Y1)
1250 XS=X1+(X2-X1)*(Y-Y1)/(Y2-Y1)+.5
1260 IF XS<0 OR XS>=128 THEN 1290
1270 IF Y<0 OR Y>=48 THEN 1290
1280 SET(XS,Y)
1290 NEXT Y: RETURN
1300 FOR FI=1 TO F(10): FOR FJ=1 TO 53: F(0)=FI
1310 POKE F(FI),RND(16)+127
1320 IF INKEY$<>"" THEN RETURN
1330 NEXT FJ: POKE F(FI),128: NEXT FI: GOTO 1300
1340 CP=1+(YC>23)-959*(YC<24)
1350 A$="21003C0100047EFE2020023E80EE3F77230B78B120F0C9"
1360 FOR I=1 TO LEN(A$) STEP 2: L=ASC(MID$(A$,I))-48
1370 R=ASC(MID$(A$,I+1))-48: L=L+7*(L>9): R=R+7*(R>9)
1380 IF INKEY$<>"" AND TE=7 THEN RUN
1390 T$=T$+CHR$(16*L+R): NEXT I
1400 POKE 16526,PEEK(VARPTR(T$)+1)
1410 POKE 16527,PEEK(VARPTR(T$)+2)
1420 X=USR(0)
1430 PRINT@CP, "<ENTER> TO RUN AGAIN ";
1440 T$="": TE=7: GOTO 1350
```

Figure 13. John Craig's "program overview" of his listing.

```
10-40       Print heading type information.
50-80       Option: Circle or ellipse?  Uses "flicker" routine at 1300.
90-130      Option: Stay in the 2 to 5 inch diameter range?
140-330     Get horizontal radius via graphic technique.  If ellipse, then
            also get "vertical radius".
340-370     Option: Want figure to stay on the screen?  Otherwise we will
            let it hang off and draw just part of it.
380-580     Locate the desired center for the figure via graphic guidance
            system.  If figure is to stay on screen then the "window" of
            legal centers is restricted.
590-650     Option: Stars with N points may be drawn, see discussion on
            following page.
660-810     Option: Star can be drawn by connecting points at various
            separation distances from each other.  The following page
            explains more on this.
820-1000    Option: The star may have one point put at any angle you wish.
            Uses the "flicker" subroutine again.  See line 1300.
1010-1090   Draw the ellipse.  For a circle the XR and YR factors are
            chosen in the proper ratio.
1100-1160   Draw the star part.  Starting point is at chosen angle and
            the points are connected at the separation chosen.
1170-1290   Subroutine for drawing a straight line from any X1,Y1 to any
            X2,Y2 points. Useful for other graphics programs too.
1300-1330   Flicker entry subroutine for up to N choices. (1<=N<=9).
            F(10) is loaded with N.  F(1) through F(N) are loaded with
            the absolute video addresses (15360 for upper left corner, etc.)
            where each flicker is to appear.  Upon return from the routine
            F(0) contains the users choice number (1 to N).
1340-1440   My "String Machine" subroutine.  Useful for running relocatable
            object code programs.  A$ contains the hexadecimal code for
            a short video inversion routine in this case.  The use of
            "logical variables" helps simplify the hexadecimal to decimal
            conversions.
```

"Lines 690 to 810 of my program allow the user to choose the number of points as well as the connection distance for the star. Lines 700 to 770 analyze the choices to make sure that a legal 'star' will result. An example of an illegal star would be trying to connect every second point out of six, as a triangle would result and three of the six points would be unconnected.

"Because of the flexibility of this test you may try some rather unusual requests and find that they are legal. For instance, referring to a five-pointed star, connecting the points separated 2, 7, 13 or even -3 points apart results in drawing the same star! And, by using -2, 3, 8, etc., the same star will be drawn, but by connecting the points in the reverse order."

Conclusion

There you have it, three winners and nine runners-up. You might have chosen differently; my choices were based mainly on ingenuity and the variety of features.

There may be a third TRS-80 software challenge some day, but not right away, due to the recurrent attacks of lassitude brought on by this one.

As with the first challenge, this second one is not a contest; "there are no prizes, other than the satisfaction of writing a program that leads the TRS-80 through a complex task. Like virtue (or vice), the program is its own reward." □

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Before a program is accepted for the MECC library it is judged on specific criteria. For example:

1) Accuracy ... Is all spelling and grammer correct? Does each question provide for a correct and appropriate response?

2) Audience ... Is the intended audience (grade level and subject) served by the degree of difficulty and scope of the program? Is the reading level of the text material suitable?

3) Clarity ... Are explanations and instructions sufficient, clear and straight forward? Is the presentation well-formatted?

4) Graphics ... Are the graphics appropriate and sufficient in quantity?

Other criteria include documentation, function, programming, and the like. Similar criteria are applied to the documentation. This insures that the reading level is appropriate, that objectives are well-stated and that associated materials are available.

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Apple Demonstration Diskette
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A sample of the different kinds of applications available on the MECC diskettes is shown. The software demonstrates applications in drill and practice, tutorial, simulation, problem solving, and worksheet generation. Samples from music, science, social studies, industrial arts, reading and mathematics are provided.

Elementary—Volume 1 (Mathematics)
MECC-702, $24.95

The first elementary diskette contains programs to be used in the elementary mathematics classroom. Games of logic such as BAGELS, TAXMAN, and NUMBER, drill and practice programs, such as SPEED DRILL, ROUND, and CHANGE, and programs about the metric system such as METRIC ESTIMATE, METRIC LENGTH, and METRIC 21 are included on the diskette.

Elementary—Volume 2 (Language Arts)
MECC-703, $24.95

The teacher can enter lists of spelling words in the computer and have them used by the program SPELL, which drills students on the spelling, MIXUP which presents the word in mixed up order, or WORD FIND, which will create a word find puzzle for the teacher to duplicate. If words and definitions are entered, a CROSS WORD puzzle can be generated or a WORD GAME can be played. Two other programs included on this diskette are TALK, a program designed to introduce students to the computer or AMAZING which prints out worksheet mazes. Several programs on this diskette use a printer.

Elementary—Volume 3 (Social Studies)
MECC-704, $24.95

The sell series, SELL APPLES, SELL PLANTS, SELL LEMONADE, and SELL BICYCLES which appears on the ELEMENTARY VOLUME 3 diskette can be used to teach elementary economics to students in grades 3-6. CIVIL will reinact battles of the CIVIL war while STATES and STATES2 provide drill and practice on the location of states in the U.S. and their capitals.

Elementary—Volume 4 (Mathematics And Science)
MECC-705, $24.95

Two mathematics programs ESTIMATE and MATHGAME provide reinforcement on estimating and basic facts. Food chains in fish can be studied through ODELL LAKE while ODELL WOODS deals with food chains in animals. SOLAR DISTANCE teaches the concepts or distances in space and URSA provides a tutorial on constellations.

Elementary—Volume 5 (Language Arts)
MECC-719, $24.94

ELEMENTARY—VOLUME 5 deals with the reading concept of prefixes. The diskette contains five lessons which both teach the prefixes of UN, RE, DIS, PRE, and IN. Two review drils, DRAGON FIRE and PRE-APP II, are also contained on the diskette.

Elementary—Volume 6
MECC-725, $24.95

Historical simulations, OREGON, VOYAGEUR and FURS are included in the ELEMENTARY—VOLUME 6 diskette. Along with these programs are NOMAD which teaches map reading and SUMER.

Special Needs—Volume 1 (Spelling)
MECC-727, $24.95

This diskette is designed to drill handicapped students on frequently misspelled primary and intermediate words. Students answer problems by either using the game buttons, the game paddles or any key on the keyboard.

Science—Volume 2 (Senior High)
MECC-709, $24.95

Many of the programs on this diskette were developed by Minnesota teachers. PEST, which deals with the use of pesticides, and CELL MEMBRANE which the user takes the part of a cell membrane, can be used in biology classes. SNELL plots light refraction demonstrating SNELL's law while COLLIDE simulates the collision between two bodies. DIFFUSION deals with the diffusion rates of various gasses, NUCLEAR SIMULATION shows radioactive decay of nine different radioisotopes, ICBM and RADAR teach angles and projections on a coordinate system.

Science—Volume 3 (Middle School)
MECC-707, $24.95

The FISH program through the use of low resolution graphics show the circulatory system of a fish. Simulations like ODELL LAKE which is used to explore food chains, URSA which teaches about constellations, and QUAKES which simulates earthquakes are on the diskette. MINERALS can be used in the area of earth science to identify 29 minerals by having students perform simple tests.

Mathematics—Volume 1 (Senior High)
MECC-706, $24.95

BAGELS, SNARK, ICBM, and RADAR will teach students logic while reinforcing the concepts of plotting prints or angle measurements ALEGBRA provides a drill and practice in solving equations. Three programs on the diskette can be used in plotting equations on a grid: SLOPE which is designed for use in ninth grade with linear functions, POLYGRAPH which will plot any equation on a rectangular coordinate system, and POLAR which graphs functions on polar coordinates.

Aestheometry—Volume 1
MECC-716, $24.95

Aestheometry teaches the topic of curves by viewing curves from two perspectives. The first method demonstrates the "space concepts" of elliptical, parabolic, and hyperbolic curves. Curve sketching designs are developed to provide an aesthetic view of geometric shapes. The second method uses a mathematical approach and defines a curve as the intersection of planes with a cone. The support booklet provides worksheets and classroom ideas.

Teacher Utilites—Volume 1
MECC-715, $24.95

The TEACHER UTILITIES diskette is designed to aid the teacher and would not be used by the student unless the teacher creates questions using the REVIEW program. This program allows the teacher to set up a list of questions which can be used either by the REVIEW program or the TEST GENERATOR program. The teacher can also make CROSS WORD puzzles, WORD FIND puzzles, BLOCK LETTER banners and POSTERS using this program. FREQUENCY and PERCENT can be used to calculate grades and to do statistical analysis. A printer is needed for some of the programs on this diskette.

Programmer's Aid—Volume 1
MECC-720, $32.95

The PROGRAMMER's AID diskette provides help for the programmer. Programs to be able to UPLOAD and DOWNLOAD to the MECC system, programs that work with text files including FP TO TEXT, RANDOM EDITOR, SEQUENTIAL EDITOR, and TEXT LIST along with programs to work with binary files, BINARY FILE INFO, BINARY FILE TO FP are included. Two programs TABLES and MERGE allow the user to create, change and merge graphic shapes for use in a program. FREE SPACE will tell the amount of space on the diskette while HIDDEN CHARACTERS will locate contol character. STARTER will put standard routines such as space bar, music, graphic characters or input into a user's program which is just being created or already created.

MICAS—Volume 1
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Shape Tables—Volume 1
MECC-724, $24.95

The SHAPE TABLES diskette includes 12 files of 187 shapes that can be incorporated in a user's program. Also included are aids needed to work with shape tables.

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chess champ

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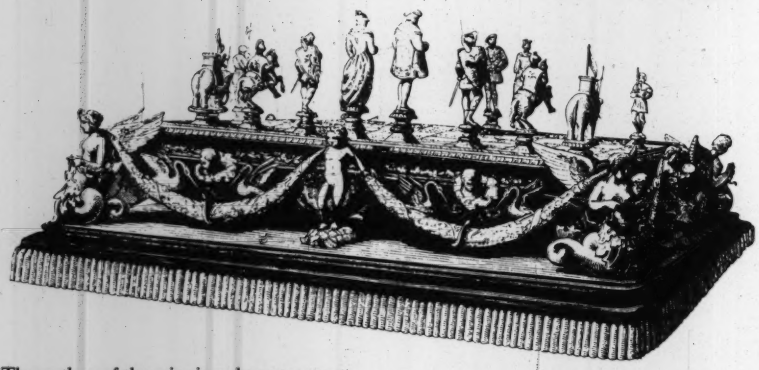

The author of the winning chess program in the second European Microcomputer Chess Championship characterizes himself as a "weakish club player," bought his first personal computer only a year ago, and copied the opening book into his tiny program straight from the pages of a paperback bought from a drugstore rack.

"Cyrus," the system written by Richard Lang of Olton, in England's West Midlands, won all five of its games in the 12-entry field, which included such popular and well-known systems as Gambiet 81, Philidor, and Chess Champion Mark V.

The quality of overall play in the tournament, which was held in the Cunard Hotel, London, in conjunction with the fourth Annual Personal Computer World Show, was put in perspective by Michael Stean, a British International Grandmaster who was on hand to analyze the games and comment on the play: "I've just returned from the junior championships," he said, "and these programs would have been a match for many of the players there."

For his win, Lang received £500, a chess set, and the travelling Centronic Trophy. Second place, worth £200, went to another home brew system, Advance 2.0, with third prize worth £100 going to a Dane, 19-year old Kaare Danielsen, playing yet another home-written system. Five commercial systems in the competition failed to place. Dead last was a system called Albatross 3.0 with a perfect 0 on the scoreboard. One wonders what versions 1 and 2 were like.

Edgar F. Coudal, 627 S. Crescent Ave., Park Ridge, IL 60068.

Lang, who wrote Cyrus in about six months of spare time after teaching himself to program, first in Basic, then in Assembler, is a 25-year old risk analyst for British Gas. He bought his personal computer—a Video Genie—less than a year before winning the tournament. The Video-Genie is a British TRS-80 look-alike. "The prize money will buy me disk drives," he said.

Lang decided to write a chess-playing program because it "seemed a good challenge, and the sort of the thing a computer should be able to do well." He said he started by studying the Spraklens' Sargon I and reading International Grandmaster David Levy's magazine articles on computer chess, then "took off from there." Perhaps Levy himself should go back and look at those articles. The two entrants he co-authored, Philidor and Philidor Experimental, each managed three of a possible five points, finishing in the middle of the pack.

"Starting almost fresh, as I did," Lang said, "is the best way of doing it. You're forced to think of your own way of doing things."

It was the first competition for Cyrus, and Lang admitted surprise at the way his program dispatched its opponents. "I had some idea of its strength," he said, "because I've played Sargon II and Gambiet 80 at home, and beaten them convincingly."

According to Stean, Cyrus is particularly strong in its ability to mount powerful coordinated attacks using numerous pieces, without the emphasis on the queen shown by many programs. Cyrus's endplay capabilities are a matter of conjecture; Lang noted, "he usually doesn't get that far before winning." All five games in the tournament were won in the middle game, with the only real fight coming in the opening match against Philidor Experimental.

His program, written in Z-80 assembly language, occupies just over 7K of memory, including an opening book table of 1.25K which "I took straight out of the Penguin paperback of chess openings." Cyrus's opening book contains only 450 moves, and "it gets out of the book rather quickly," he said, "except for something like the Ruy Lopez where it will play to nine moves for each side."

Cyrus has seven levels of play, with level 1 responding in a quarter of a second, and level 7, with its seven-ply search, taking "several hours per move. I've never actually played at Level 7," he said. "I haven't the patience, but perhaps it would be good for postal chess or something of the sort." Cyrus played at Level 5 during the tournament, with an average of about 105 seconds per move.

In explaining how the program operates, Lang said that it has a function which assigns a value to the possible board positions, and selects the move which will lead to the highest total, five moves ahead. "That total can range from 0" he said, "to...well, perhaps I better not say...I don't want to give too much away." He considers the speed and accuracy of that evaluation system to be the strongest part of the program.

In general terms, Cyrus uses a depth first alpha-beta search with the killer heuristic and employs selective "pruning" of the tree. The amount of "pruning" is increased in complex situations to keep the thinking time reasonably constant. Cyrus, he added, examines about 200 positions a second and includes an allowance for future captures in each assessment.

When last seen, Lang was fending off potential marketers while gathering his Video Genie and his mother and father, who had driven in for the tournament. His last comment was, "Cyrus Version 2 is almost finished. It will be considerably stronger. □

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Finke.

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So began Commodore International President James Finke at the Boston Computer Society's forum on The Future of Personal Computers held during the Northeast Computer Show in Boston in October.

BCS President Jonathan Rotenberg once again astonished the industry by assembling probably the most impressive array of personal computing power ever to be gathered in one room: Peter Rosenthal, director of business planning and development for Atari; Philip D. Estridge, "the creator of the IBM personal computer"; Finke; William H. Gates, president of Microsoft; A.C. (Mike) Markkula, president of Apple; Jon Shirley, vice president of Radio Shack computer merchandising; and Nigel Searle, executive vice president of Sinclair Research.

If the showgoers and BCS members who packed the large auditorium were expecting a fight or an accidental pre-announcement, they were disappointed. For the most part, the leading lights of the industry agreed

Participants in the BCS Forum (left to right): Nigel Searle of Sinclair Research, William Gates of Microsoft, James Finke of Commodore, Peter Rosenthal of Atari, Jon Shirley of Radio Shack, Philip Estridge of IBM, Mike Markkula of Apple, and Jonathan Rotenberg of the Boston Computer Society.

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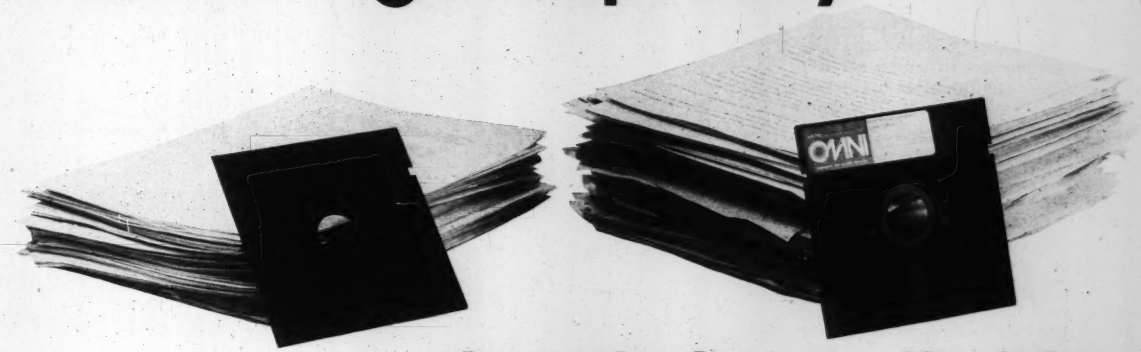

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that the future would see some changes, but each had a slightly different view of what would change and how.

In addition to putting the size of the personal computer market in perspective, Finke stressed the importance of the consumer and the dealer in the growth of the market. As an example, he described a telephone conversation in which a customer's computer malfunction could be diagnosed and cured over the phone. Apparently "user-friendly" is still a byword at Commodore.

Space Invaders vs. VisiCalc

Rosenthal reiterated Atari's commitment to the home market and underscored the importance of games by comparing the total sales of Space Invaders (2.5 million copies) to sales of VisiCalc (150,000 copies). He also spoke at length about the potential for "electronic services," projecting uses ranging from job searches to software rental.

Markkula spoke about the ergonomics of the interface between the personal computer and "the broadest possible spectrum of users," and spoke optimistically about the standardization of hardware and software among computers manufactured by different companies.

Down With Software Protection

In perhaps the most surprising and controversial statement of the evening, Markkula urged the elimination of software protection. The software pirates in the audience applauded.

He likened software publishing to traditional publishing, which, he said, "operates on the premise that the content does not determine the value. But rather the cost of manufacturing the media and the cost of distribution determine the value."

He believes that "as our industry matures, and as the volumes get large enough, we will head in that direction." He promised that Apple "will work as diligently as we can to try to eliminate the situation that we call software protection."

Markkula.

Rosenthal and Shirley.

Rosenthal responded to Markkula's position with the statement that Atari "is taking a very strong position in trying to get some legislation enacted which will protect software legally—not just the code, but what appears to the end user, regardless of how one gets to that point."

"In the 80s, programming will be the most profitable, most rapidly growing, best investment in the industry."

Shirley, speaking from Radio Shack's perspective, added that "the one major cost in software that makes the software industry different from books and records and tapes is supporting the user. Because, until you reach the ideal situation where using a package is as easy as reading a novel, software is not going to be sold based on the cost of media."

Estridge began by acknowledging the past contributions of the personal computing "pioneers, several of whom are seated at this table with me." He echoed Finke's prediction that "ease of use for the end user and end user productivity will be the keys to success in personal computing the decade to come.

"In the 80s," Estridge said, "programming will be the most profitable, most rapidly growing, best investment in the industry, and the only way to succeed in this critical area is to treat programming and software, its product, as a serious business. The threat to this is copying; it has to stop and it has to stop now." The software manufacturers and authors in the audience applauded.

He discussed the future of programming, and concluded by asking "that programmers not forget that those of us who would like to use the machine don't feel obligated to understand it.'

Uncle Clive Cops Out

No one really believed that Clive Sinclair, president of Sinclair Research, Ltd., would show up for the forum as promised in the announcement, but a few of us, knowing Jonathan's incredible persistence, clung to that promise right up to curtain time.

Estridge.

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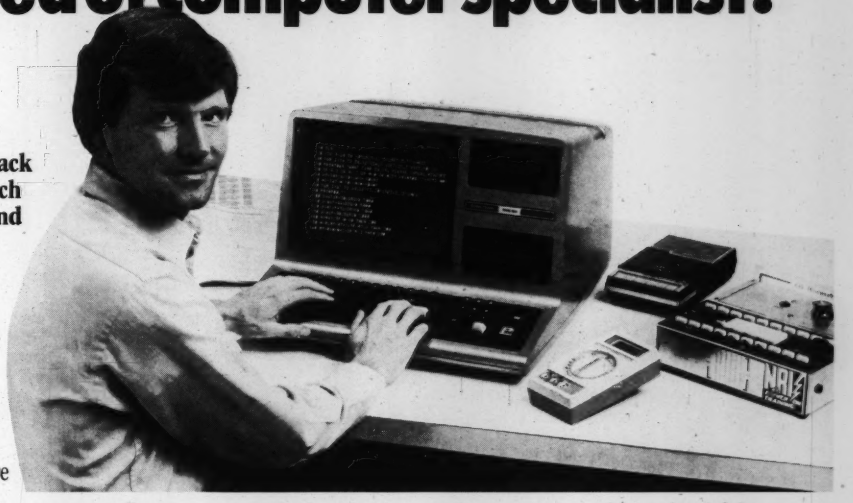

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Future, continued...

After all, who in the U.S. has ever heard Uncle Clive speak on anything?

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Nigel Searle was a worthy substitute, speaking on the consumer marketplace for personal computers. He began by stating that "there clearly is no consumer marketplace today."

Searle.

Agreeing with Rosenthal, Searle predicted that "the personal computer will become a mass market item when it has a communications capability," and that when that happens, most consumers will use it to deal with financial matters—banking, bill paying, and dealing with the government.

He warned, however, that govenment regulation and groups seeking to "protect" the consumer from invasion of privacy by computers could keep the full potential of personal computers to improve the quality of life from being realized.

Encore?

The conclusion of this year's BCS forum left us wondering what Jonathan will do for an encore—perhaps a panel on copy protection featuring confessed software pirates. □

Needless to say, far more was said in the 2-1/2 hour session than we reported here. The panel painted an insightful picture of how personal computer hardware and applications will evolve in the coming years. The role of the computer in society and its impact on individuals was also discussed at some length.

Two C-90 tape cassettes containing the entire forum—presentations, introductions, questions, answers and audience reactions—are available. The set of two cassettes in hard plastic boxes costs just $25.00 postpaid from Creative Computing, 39 E. Hanover Ave., Morris Plains, NJ 07950. In a hurry? Order with your credit card by calling toll-free 800-631-8112 (in NJ 201-540-0445).

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CIRCLE 251 ON READER SERVICE CARD

Courting the Digital Muse
—with a little help from microSpeed

James L. Hockenhull

Throughout history, art has been created with a mind-boggling variety of tools and materials including animal hair, ground-up minerals, vacuum-forming presses, mummy dust, cartridge casings, burnt wood, bulldozers, and thin air.

It should come as no surprise, then, that today some people believe that satisfying, evocative art can be made with computers. I am one of them. An artist by profession, with no particular background in science, I discovered computers almost by accident about three years ago.

In this article I will describe my general approach to art-making with a computer, and share some of the thoughts I've accumulated. My object is to inspire more minds to work on this fascinating business.

Art vs Graphics

To clear the air at the beginning, I think it is important to make a distinction between computer art and computer graphics. While the two fields share many of the same tools and methods, their ultimate aims are different. It is the nature of graphics (computer or otherwise) that no matter how "artistic" they may become, they are always done in the service of some goal external to themselves.

Graphics can convey information (by signs and symbols), clarify information (charts, graphs, and illustrations), liven up a dead space (the plague of "super-graphics" visited upon public places), and, of course, sell things (advertising and other forms of visual propaganda).

Art, on the other hand, while it may partake of some or all of these instrumental functions, presumably has some *terminal* function, some purpose in and of itself—art for art's sake, if you will. This is not the place (and I am not the person) to debate the sticky questions raised by all this. I do, however, think that the distinction has some truth to it.

Computer graphics is a well-established discipline, a branch of computer science. It is heavily dependent upon specialized, expensive equipment owned by large institutions. Computer art is unexplored territory, with the excitement, frustration, and danger of any frontier, and I am convinced it can be created on personal computers in the privacy of one's home.

It is important to make a distinction between computer art and computer graphics.

(Note: in the remainder of this article "graphics" will be used in its conventional sense, referring to things that make visual images, e.g. "graphics routines" or "turtle graphics." It will not refer specifically to the discipline of computer graphics.)

The Computer As Instrument

If you were to speculate on ways in which a computer might be used to make visual images, you would probably soon come upon the idea of manipulating input into a program which would transform it into suitable output. A joystick or light pen might be used to draw a picture on a video screen, for example. Since the computer would respond to what the operator is doing and the operator would respond to what the computer is doing, this would be an "interactive" approach. It uses the computer as an instrument to be guided by a human being.

While it is certainly useful for graphics applications, I do not feel that this is the most fruitful approach to art-making. If you want to use a computer interactively to create something akin to a traditional drawing, that is, a visual structure based on human experience, intricately organized and subtly executed, you will need more than a personal computer.

The Apple II high-resolution mode, as good as anything in its price range, deals with a screen 280 dots wide by 192 dots high. You can't even draw a smooth circle at that resolution much less a complex, convincing picture. For that you need access to one of those big, expensive graphics systems I mentioned, which means getting hooked up with a large institution. Access is not always easy, and most of the artists I know are put off by what they perceive as the white-coat-and-clipboard ambience of such places. They'd just as soon buy a stick of charcoal and do their own drawing.

The Computer As Composer

What if, instead of trying to interact with the computer, we designed a program which required no input at all to produce visual images? Such a program could be the embodiment of rules, principles, or "heuristics" which would guide the computer in its development of art works. The program would be an *art idea* stated in a form which the computer could understand.

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gram would be *implications* of that idea. This resembles the way a human artist works. When we speak of Picasso's Blue Period we are saying that the man had a guiding idea which, when set in motion, allowed him to produce a group of works, each unique, but all having a relationship to one another—each, in fact, an implication of his overall concept. The computer could be doing the same sort of thing, only tirelessly and much, much faster.

There need be no direct human control over the specific configuration of an image at any given moment. The computer could handle all that messy minutiae. The artist would be involved at a higher level, directing his or her attention away from the details of making an object, toward the details of the processes which lie behind (or above) object-making. To use a musical analogy: rather than being an instrument the computer could be a composer.

Procedures are the equivalent of the artist's skill and technical knowledge.

Oh Yeah?

Using the computer as a composer does not require any revolutionary techniques. Such programs already exist. You can easily write one yourself by following this sequence on a computer with graphics capabilities:

Program A

1) Get a random X coordinate.
2) Get a random Y coordinate.
3) Get a random color.
4) Plot a colored dot at X,Y.
5) Do the above 100 times.

Program A requires no input, follows a set of guiding principles, takes care of the details of specific configurations, and, if the random number generator is any good, won't repeat itself from run to run. The images produced will have a family resemblance. The machine will be in its "One Hundred Random Dots" Period. Granted, the rules embodied in the program are ridiculously simple but, on a primitive level, the computer is able to create new, unique things. Program A would be fascinating to watch—for about a minute and a half.

A slightly more sophisticated version could act as a simple kaleidoscope:

Program B

1) Get a random X coordinate on the left half of the screen.
2) Get a random Y coordinate.
3) Get a random color.
4) Plot a colored dot at X,Y.
5) Reflect the X coordinate over onto the right half of the screen.
6) Plot a colored dot there.
7) Do 100 times.

The rules of the program have been altered only slightly, but that alteration has introduced a strong ordering principle, the symmetrical arrangement of dots around a vertical axis. The ordering may well prove to be so strong and so easy to perceive that the visual production will be as dull or duller than those of Program A. It would then be up to the artist/programmer to continue development toward some interesting balance between order and chaos, predictability and surprise.

We are now looking at a very simple model of art making. We have the art idea (which, you will notice, is still formulated by a human being), we have a way to implement the idea, and we have art objects (well, visual images at least) which are implications of that idea.

Procedures and Planning

If we analyze Program B further, we see that parts of the program are about *how* to do things—the part that can plot a point and the part that can reflect a point. Let's consider them to be semi-autonomous little programming entities and give them nice, computerish names in capital letters: PLOT and REFLECT.

Other parts of Program B are concerned with telling PLOT and REFLECT *what* to do: where to plot a point, what color to make it, whether or not to reflect the point (always an affirmative decision in our example), and how many points to plot. The first two of these are stated very explicitly; the others are implicit in the structure of the program.

Planning is analogous to the ideas and overall sensibilities that put the artist's skills to work.

I call the "how" parts of the program *procedures*, the "what" parts *planning*. Another level of complexity has been added to our model of art making. Procedures are the equivalent of the artist's skills and technical knowledge; planning is analogous to the ideas and overall sensibilities that put the artist's skills to work.

Even in a program as trivial as Program B we have been able to lay the groundwork for an approach to thought and work that has a resemblance to the way a regular human artist thinks and works. The way is clear for the artist/programmer to try to "teach" new skills—new procedures—to the computer and to figure out plans of things to do with them.

Modularity

When we consider our procedures to be "semi-autonomous entities" we are thinking in terms of *modularity*, a habit that makes programming much easier. I would go so far as to say that the modular method is the only way in which a program of any significant complexity can be designed.

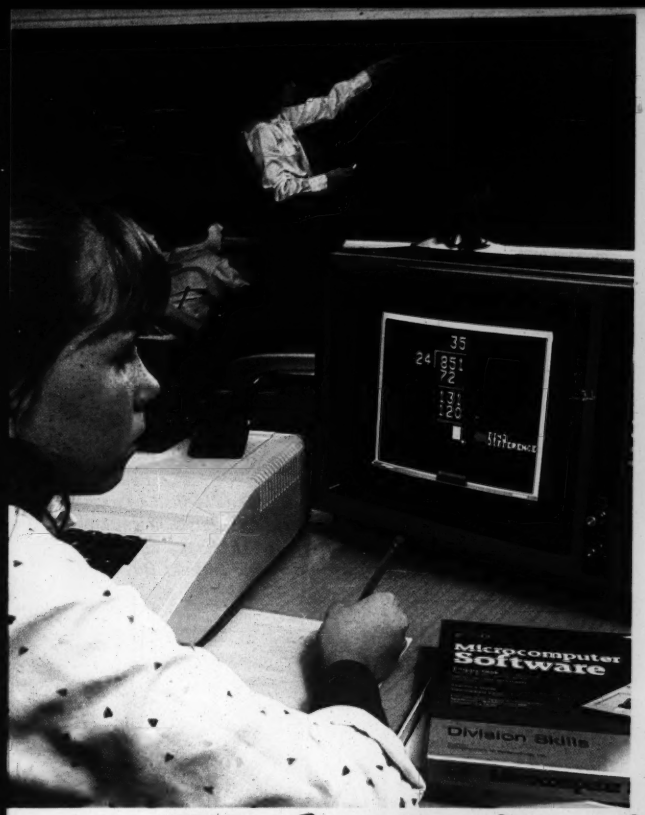
A *module* is written as a discrete piece of code, usually requiring the input of data from some other part of the program, producing new data as output or creating some other desired side effect. Once a module is working properly it can be treated as a "black box"; its inner mechanism can be ignored.

PLOT, one of our two procedures in Program B, is a module requiring screen coordinates and color as input, producing no output but having the effect of lighting up a dot on the screen. REFLECT has two parts, the first calculating a new X coordinate, the second issuing a call to PLOT. Modules, thus, can be used as building blocks for other modules. Complex procedures are built of simpler procedures which, in turn, are built of even simpler procedures until we reach the bottom-level modules, *primitives*, which finally do the work.

A graphics system needs three such primitives: the ability to move to any point on the drawing field without making a mark, the ability to do the same but plot a point there, and the ability to draw a line or *vector* between two points. (Actually, the line-drawing routine involves calls to the plotting function so it is at a higher level; we'll consider it a primitive anyway.) Using these basic procedures we could, for example, design a simple module which would draw a rectangle given the coordinates of its diagonally opposite corners; we might call it BOX. If, later on, we felt the need to draw a border around the limits of the drawing field we could design a module, BORDER, which would feed the coordinates of those limits to BOX. Simple, huh? And, if BOX works fine but BORDER doesn't, we know exactly where to look for the problem. Modular design lets us debug a program in much the same manner as following the trouble-shooting keys in an automobile repair manual: if the right stuff is going into Unit X but the right stuff isn't coming out then something's wrong inside Unit X. Debugging a non-modular program is like looking at a car and seeing nothing but a pile of unrelated parts.

Languages, Basic and Otherwise

So far I've attempted to present an approach to art programming based on a



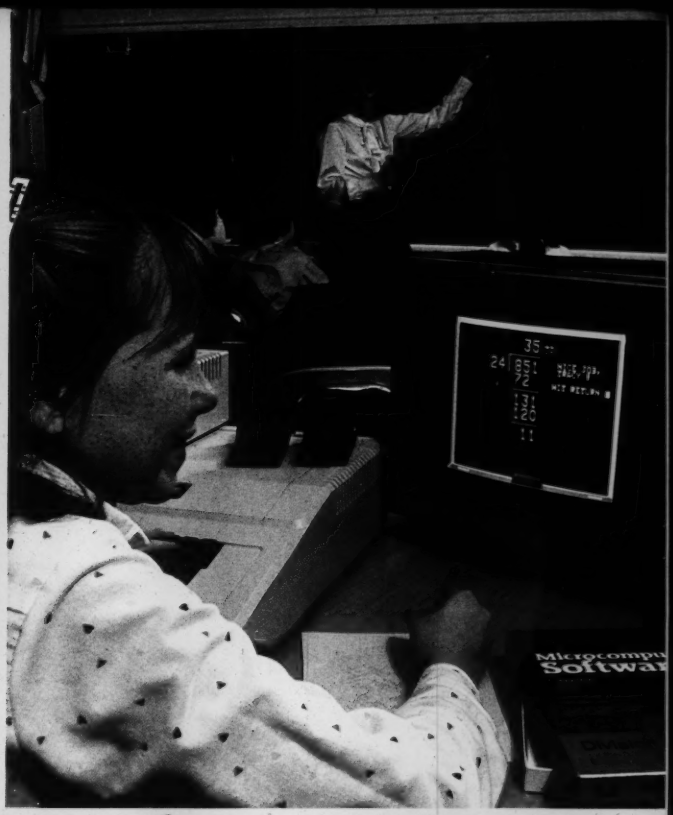


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Figure 1. Painter 2.1; a typical image. The "skills" of the program lie in a group of procedural subroutines which can draw roughly-symmetrical shapes, assymetrical shapes, squiggly and straight lines. Painter is written in Apple Integer Basic.

Figure 2. Painter 3.0. In this later version the procedures have been expanded to include the production of closed curves; "transparent" shapes; tight, loose, and concentric outlines; and a kind of pseudo-shaping.

Figure 3. "The French Movie." The Painter procedures are called by a planning routine which uses them to draw a landscape and take it through seasonal variations. The exact configuration of the image varies from run to run.

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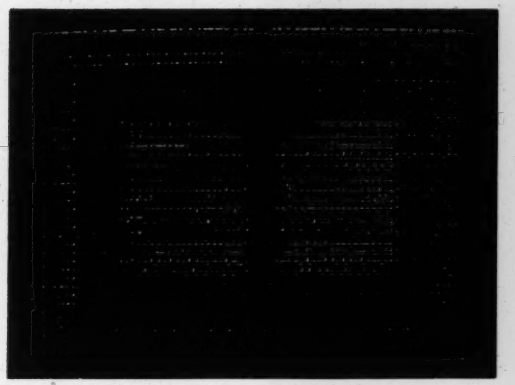

Figure 7. "Faint Squares." An early program which uses the phenomenon of optical mixing to compensate for limited range of colors available on the Apple.

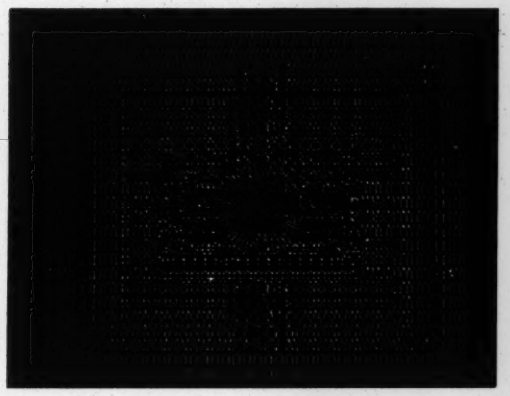

Figure 8.

Figure 9.

Figures 8 and 9. Veils.1. A work-in-progress based on the ideas in "Faint Squares" (Figure 8) but with an expanded set of procedures. The emphasis in this program is on the orchestration of events in time. Veils is written in microSpeed.

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very general, highly simplified notion of how a human artist works, a hierarchy of modular procedures analogous to skills and techniques called into service by a high-level planning routine—the overall art idea. I will now discuss suitable languages in which to phrase these concepts. Discussing computer languages is like discussing religion or politics; I'll try to tread as lightly as possible.

My guess would be that most readers of *Creative Computing* are involved with small, personal computers. This, in turn, makes me venture that most readers who program do so in some dialect of interpreted Basic, the *de facto* standard language for home computers. Basic can be used to write programs based on the ideas I've outlined above, with subroutines as the modules. In 1979, using Apple Integer Basic, I wrote a series of art-generating programs, lumped under the family name of Painter, which were built around a cluster of procedural subroutines called up at appropriate times by a main planning routine. In fact, it was during the early stages of Painter's development that the notions of modularity and of the separation of planning and procedure came to me.

The subroutines carry out such art activities as drawing more-or-less symmetrical colored shapes, drawing tight or loose outlines around the shapes, drawing a squiggly line in the general direction of a point, and more. (See Figures 1 and 2.) Once the subroutines were developed I was free to write different "front-end" planning routines to see what effects they might have on the images produced.

I found, as I had expected, that I could achieve great visual variety from the same procedures, even turning my abstract Painter into a landscape painter in a lighthearted program entitled "The French Movie." (See Figure 3.)

Although modular programs can be written in Basic, the language is little help. Modularity does not seem to come naturally to Basic. For instance, subroutines are referred to by line number, the form being GOSUB (line number). The calling program is responsible for somehow generating the correct line number at the proper time. Various Basics have different provisions for this. Integer Basic, for example, permits the *computed GOSUB* which allows the substitution of an arithmetic expression for an actual line number—the computer can calculate a line number on the spot. The computed GOSUB is useful if treated with respect, but it is awfully easy to compute oneself off into the great Programming Void. Applesoft—Apple floating-point Basic—disallows it, providing instead the ON...GOSUB statement of the form: ON (arithmetic expression) GOSUB (line number), (line number), (line number),... where the expression must take on a value corresponding to the position of the desired subroutine in the list of alternate line numbers. I find this statement so unaesthetic that, to the best of my knowledge, I have never used it.

Be that as it may, the point here is that subroutines are *location dependent*, meaning that if they must be expanded beyond their allotted slots in the program or moved somewhere else, lots of adjustments must be made, and that a great deal of programming effort will be spent worrying about line numbers when it could better be spent worrying about ideas.

Parameter Passing

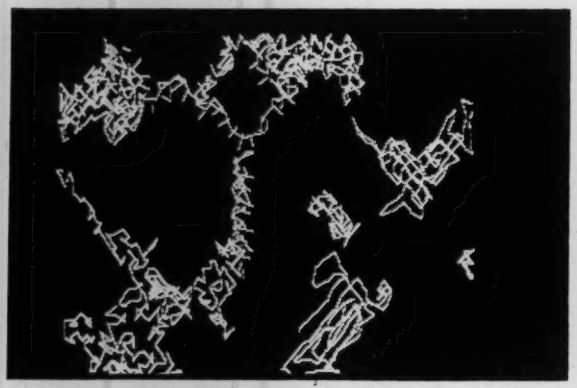
Another hindrance to effective modular programming in Basic lies in *parameter passing*, the business of getting the proper data to the module. In a simple dialect of the language, such as Integer Basic, there is really only one way to do this: have the calling routine assign the correct value to a variable and have the called subroutine use that variable in its operation. All Basic variables are *global*, that is, all parts of the program have access to them. It is very easy to lose track of which values are actually being passed to a subroutine, or even which variable names are in use. A distant part of the program may be having some undetected effect on a variable, leading to many happy hours of debugging.

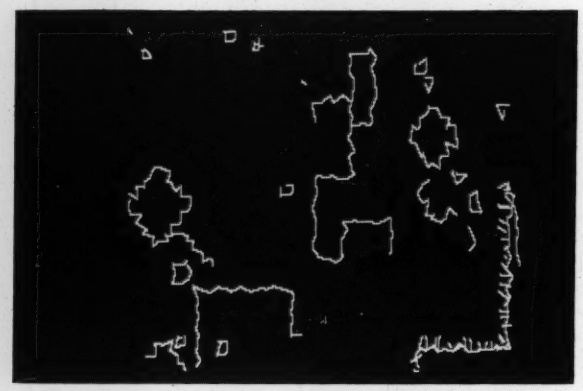
But look at a statement such as the Integer Basic "RND()." RND(n) produces a random integer in the range 0...n-1. There can be no doubt about the value being used by RND() because it is explicitly stated between the parentheses. RND() is a true *function* requiring an *argument list* (in this case the single integer in parentheses) and returning a *value*. It requires a certain kind of input and produces a certain kind of output.

Functions are a part of the set of commands of any Basic, but they cannot be written in all versions of the language. Where they can be written, they must be kept small, sometimes limited to a single argument and one program line. A computer language is itself a program, but in Basic there is a distinct difference between the way in which the language is written and the way in which programs can be written in the language. This is not true for all computer languages, as we shall see later.

Running Speed

A third problem related to Basic modularity is that of running speed. In 1980 I wrote a series of programs, again in Integer Basic, which created black and white line drawings on the screen by remembering past actions and basing future decisions on that information. (See Figures 4 and 5.) The procedure modules performed such tasks as checking to see if an area of the screen had already been occupied and updating the program's internal representation of the condition of the screen. The planning routine was a formulation of a set of rules governing behavior under all relevant situations.





Figures 4 and 5. Smartsketch does line drawings by remembering its past actions and basing subsequent decisions upon that information, guided by a set of rules which govern behavior under all relevant screen conditions. Slight changes in the rules cause great differences in the drawings, as seen in these two versions of the program.

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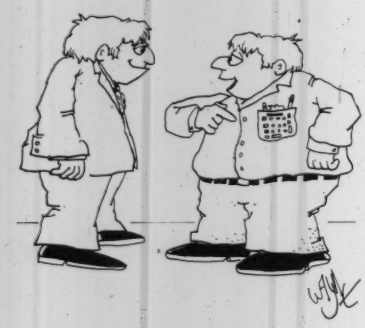
Slight modifications of the rules often produced great changes in the appearance of the drawings. I am still quite pleased with the program—except that it runs like cold molasses. I want my art programs to be entertaining to watch in action; I don't believe that people will sit quietly for 10 or 15 minutes watching a black line meander around a white screen, no matter how "intelligent" its meanderings may be.

Not only is interpreted Basic slow-running, it gets slower as your programs become more elaborate and sophisticated. You pay a speed penalty ("run-time overhead") for the overall length of the program, for the length of variable names, for the number of variables used, and for the number of comments (REMarks). Speed is affected by the location of routines within the program and of variables within the variable table. This all means that the more modular your program is, the slower it will run.



"It's my pocket computer."

I want my art programs to be entertaining to watch in action.

After several years of experience I am convinced that if you set out to design a language to discourage good programming habits you would end up with something very close to interpreted Basic. (The speed problem is being alleviated by several Basic compilers now on the market. The structural weaknesses remain.)

Fortunately the days of the single-handed rule of Basic over the world of personal computers are coming to an end as more and more high-level languages are made available for small systems. Pascal is the most visible of these but other formidable contenders are making their appearance—powerful languages like LISP and C.

At present I am working with an intriguing language system called microSpeed, a well-integrated combination of software, based on Forth, with a hardware arithmetic processor. MicroSpeed allows, in fact demands, a strictly modular approach to programming. One begins with a system-supplied kernel of commands or modules called *verbs*. Programming consists of using these as building blocks to define new verbs—precisely what I have been describing here. Verbs defined by the user are treated with exactly the same importance as those supplied by the kernel. There is no discernible distinction between the language and what can be written in it. The microSpeed programmer actually designs a customized language for his own purposes.

Arguments (data) are passed to verbs through a *parameter stack*. A stack, one of the most basic data structures, is simply a pile of numbers, often likened to a stack of trays in a cafeteria. You can push a number onto the top of the stack and you can pull a number off the top. This is called a *last-in-first-out* (LIFO) structure. When a microSpeed verb needs an argument it uses whatever number happens to be at the top of the stack. Parameter passing involves making sure that the right

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information is in the right place at the right time.

MicroSpeed is a compiled language rather than an interpreted one. (This is not *quite* true, but true enough for our purposes.) Compiled verbs are simply lists of the addresses of their component parts. Program interpretation runs like a thread down through the levels of these lists until it arrives at a machine-language primitive which does the job.

Among other things this means that microSpeed code takes up little room in memory and it runs very fast—faster still because of the hardware arithmetic processor. There is no run-time speed penalty to be paid for program length, length of variable names, location of verbs or variables within a program, nor for comments. A bit of overhead is accumulated with hierarchical depth, that is, with the number of levels through which verbs are used to define verbs, etc.

MicroSpeed code takes up little room in memory and it runs very fast.

MicroSpeed really shines in those situations, familiar to us all, when you find yourself saying "Why doesn't this #*%!! language have a command to (fill in the blank)?" My Basic programs made extensive use of the Integer Basic RND() function, described earlier. The microSpeed kernel doesn't provide such a verb. No problem. I simply defined (wrote) a verb called RANI (*RAN*dom *I*nteger) which takes a single integer as an argument, gets a random floating-point number between 0 and 1 by calling a system verb, multiplies the two together, converts the product to an integer and returns it at the top of the stack.

My 10 RANI works exactly like the Integer Basic RND (10) and I can make it a permanent part of my own customized language if I wish.

The example above points out one of the peculiarities of Forth-based languages. RANI will expect its argument to be on the top of the parameter stack, so the calling program must push that argument onto the stack before invoking RANI. Thus, arguments precede calls to verbs. My 10 RANI says: push 10 onto the stack

At first microSpeed has a kind of backwards feel to it.

then call the verb named RANI which will make use of it. At first microSpeed has a kind of backwards feel to it. (I should say here that if data on the stack is manipulated with excessive "cleverness" microSpeed's parameter passing may become as obscure as Basic's. The key word here is "may"; it doesn't have to.)

Let's look at an example of hypothetical microSpeed code:

```
RIGHTCONDITION?
IF
  NEWACTION
ELSE
  OLDACTION
THEN
```

Since IF is just another microSpeed verb—one which tests a condition—it should come as no surprise that the condition to be tested must be on the stack before IF is invoked. Here RIGHTCONDITION? is a verb which returns a truth value for that purpose. If this value is TRUE (not zero), then the verb NEWACTION will be called. Otherwise OLDACTION will be performed. THEN merely marks the end of the conditional structure. RIGHTCONDITION? may be a simple logical operator or it may be the top level of a vast mountain of programming; the same is true for NEWACTION and OLDACTION. It doesn't matter; they are black boxes.

Now suppose that RIGHTCONDITION? had originally been written to check 37 selected points on the screen and return TRUE if they were all orange. If we decide later that that's a dumb condition with which to be concerned, we could redesign the verb completely, perhaps making it check the time from a clock card. That change would make absolutely no difference to our IF...ELSE...THEN structure. The microSpeed verb modules provide the flexibility needed to revise and "tune" art programs.

So I finally have at my disposal a language that is modular, structured (there is no GOTO), compact, extensible, and very fast. It includes auxiliary verbs for high-resolution and turtle graphics, making it a very attractive package for art-making.

Walkin' the Turtle

In ordinary, run-of-the-mill computer graphics the basic entity is the point which has the two properties of *location* and *color*. In turtle graphics the point is replaced by an entity affectionately known as the "turtle." It has three properties: location, color, and *direction*. The turtle can be thought of as a little animal that can be walked around the screen or as a vehicle which can be turned in any direction and driven any distance on that heading. This seems to relate much more closely to the way an artist guides a drawing tool around a surface than does the system of Cartesian (X,Y) coordinates.

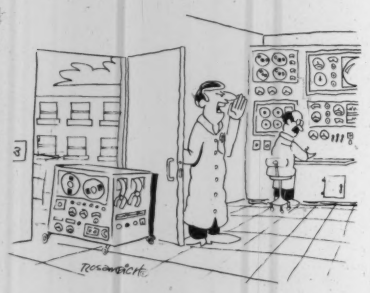
MicroSpeed turtle graphics verbs include MOVETO and TURNTO which perform moves to *absolute* locations or directions on the screen: ‹x y› MOVETO acts as a normal plot function, placing a dot at point (x,y); ‹n› TURNTO will point the turtle n degrees clockwise from "north," the top of the screen. The verbs TMOVE and TURN perform moves *relative* to the turtle's current position and heading: ‹n› TMOVE moves the turtle n units in its present direction, drawing a line in the process; ‹n› TURN changes the turtle's heading by n degrees, clockwise if n is positive, counterclockwise if negative. A triangle with sides of length 25 could be drawn by typing the sequence

```
 25  TMOVE
120  TURN
 25  TMOVE
120  TURN
 25  TMOVE
```

After a brief learning period with microSpeed, I altered the turtle graphics verbs to better suit my needs, which indicates how flexible and accommodating the language really is. I began by changing MOVETO so that it moved the turtle to a new X,Y position but did not plot a point there. Next, I replaced TMOVE with the verb FORWARD which made a relative move in the turtle's current direction but, unlike TMOVE, had the option of not drawing a line during the move.

To draw or not to draw is determined by the value of the variable PEN. If PEN is TRUE (non-zero) a line is drawn; if PEN is FALSE (zero) the move leaves no trace. The status of PEN can be controlled by the verbs PENDOWN (draw) and PENUP (don't draw).

I also added the verbs RIGHT and LEFT to supplement TURN. RIGHT is merely a renaming of TURN; LEFT first changes the sign of its positive argument



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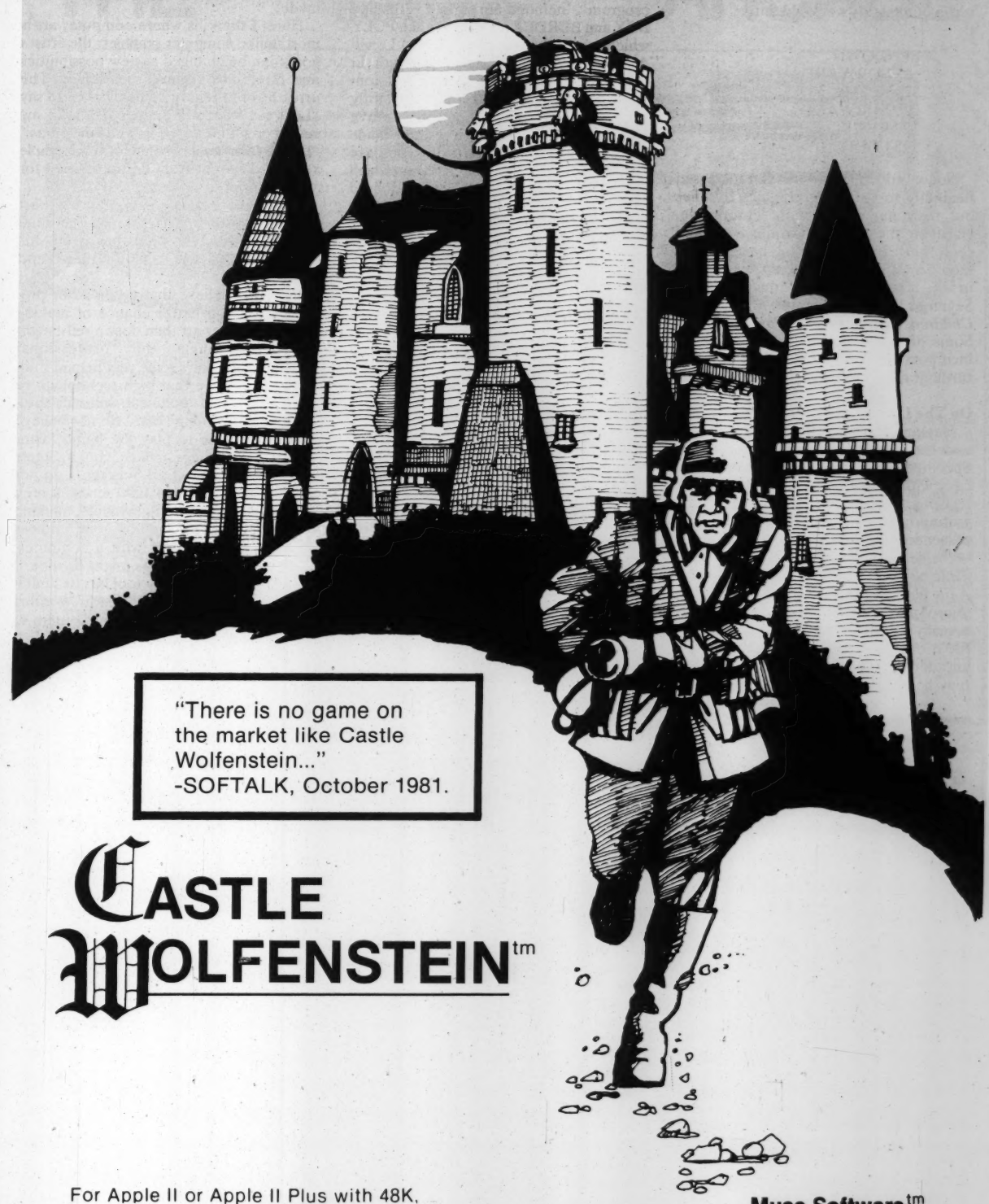

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to negative, then calls TURN, causing a counterclockwise move. To draw a triangle with sides of length 25 with my modified turtle commands we could enter:

```
PENDOWN
 25 FORWARD
120 RIGHT
 25 FORWARD
120 RIGHT
 25 FORWARD
```

Not only do the new verbs give increased flexibility to the turtle graphics routines but their names are more descriptive, clarifying the operation of the command sequence. Incidentally, I based these modifications on turtle graphics written in the Logo language, described by Seymour Papert in his book *Mindstorms: Children, Computers, and Powerful Ideas*. Some of my new verbs have since been incorporated into the microSpeed standard turtle graphics vocabulary.

On The Levels

Having a few years of Basic experience under my belt I have approached microSpeed programming slowly and methodically with an eye to my long-range needs, resisting the urge to plunge in and begin writing full-blown art programs. I began, as mentioned, by altering the turtle graphics verbs somewhat. Next, I wrote a *header file* to be used by all my future art programs. A *file* here refers to a bunch of uncompiled microSpeed *source code*, the stuff you actually write from the keyboard. A header file is one which will be compiled before another source file so that its modules may be accessed by the higher-level file.

I do not believe that a computer professional has a better chance of making good computer art than does a self-taught artist.

Mine includes some general-purpose utilities such as RANI, and declarations of certain universal variables and constants. For example, the variable XL will always represent the value of the present "window" or working area. The constant KXL always contains the absolute left-hand limit of the screen. (Constants differ from variables in microSpeed. In Basic, constants are just variables that are never supposed to be assigned new values.) Use of the header file permits an appreciable amount of standardization between my programs, which helps ease the chore of programming.

After writing the header, I put together a file of "graphic utilities"—procedures which are likely to be needed by many art programs. Included are simple verbs like BOX and BORDER and goodies like POLY which, given the arguments N and L, will draw an N-gon with sides of length L, centered on the turtle's current location, and WIGL which behaves like a slightly tipsy turtle attempting to move FORWARD. These files grow and change as my needs become clearer. They are providing a good, solid foundation on which to build my works of art. I have adhered to the principles of modular hierarchies throughout. (See Figure 6.)

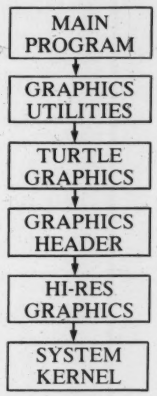

Figure 6. The hierarchy of modules used by the author to write art-generating programs in microSpeed.

But Where's The Art?

I begin work on an art program with an idea for either a procedure or a bit of planning. (I freely admit that procedural ideas are easier to come up with than are planning schemes. Learning how to do something is fairly straightforward compared to figuring out what to do with that knowledge.)

I might try to model some fundamental art-making activity such as drawing a wiggly line; the Painter programs developed from this approach. Or I may deal with some peculiarity of the computer as in my program "Faint Squares" which compensates for the limited range of colors available on the Apple by laying down veils of colored dots to be mixed optically by the viewer—Post-Impressionism for the 1980s. (See Figure 7.) Occasionally a planning idea will come first; Smartsketch is such a program. And sometimes a program will, itself, suggest ideas for new programs. (Figures 8 and 9.)

In any case, I have no fixed idea of how the images will look when I am finished. The surprise of seeing the myriad results of a routine when it is running is one of the pleasures I get from working with a computer. At that point I sit and watch, often for hours, getting the feel of what is happening, and noting where major changes or minor adjustments might be made.

Here, I think, is where computer art is most unlike computer graphics: the artist's goals can be changed as new possibilities and directions suggest themselves. The artist has the luxury of being able to say "Let's see what will happen if ..." (In my recent programming notes I find the phrase, "Desire for complex behavior from simple rules ... different from desire or need for "correctness.")

Here, too, is where computer art most resembles the ordinary kind: the final responsibility lies with the artist, his experiences, skills, sensibilities, and visions.

I do not believe that a computer professional has a better chance of making good computer art than does a self-taught artist, although the professional undoubtedly knows some very helpful stuff. I do not believe that high technology or high degrees of technical skill will automatically make high art. I do not believe that being able to play the banjo faster than Earl Scruggs makes you a better banjo player than Earl Scruggs. I do not believe that you need 1000 x 1000 screen resolution, 64 levels of gray scale, blinking bit-planes, and two million color choices in order to create art with a computer, although all those things might be nice.

I do believe that any tool has its limitations and that true skill lies in working within those limitations, turning them to your advantage.

Contrary to the opinion of what might be called the "art-treasure" school of thought, I do not believe that art is a property of objects. Rather, I think that art is a property of ideas. Objects are just spin-offs of ideas.

Conclusion

I have put forth a very general conceptual framework within which to develop programs for the generation of art. It should prove a useful starting point for those who want to tackle the problem. I have emphasized modularity and hierarchical levels of complexity organized around a clear separation of procedures from planning. Programs written in this manner are capable of squeezing a rich variety of images out of a central idea.

Nobody knows yet what computer art is or what it is capable of becoming. There are no rules, no Academies. It is a wide-open area waiting for imaginative exploration. I hope I have managed to sketch out a rough map and arouse interest in some potential pioneers.

The microSpeed Language System is a product of Applied Analytics Inc., 8910 Brookridge Dr., Upper Marlboro, MD 20870. The user's manual is available separately. □

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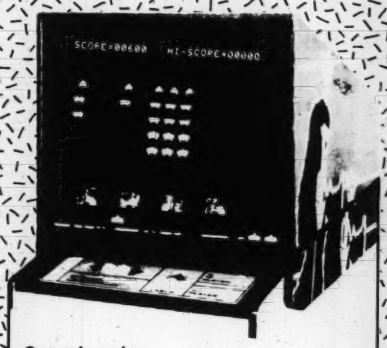

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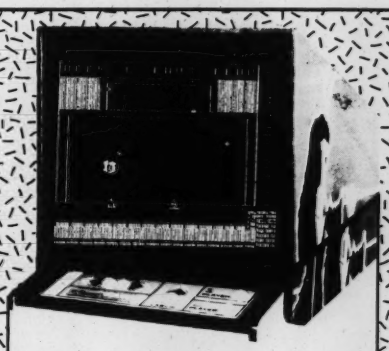

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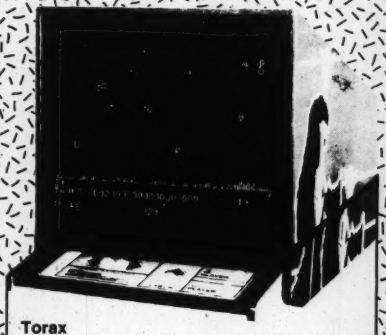

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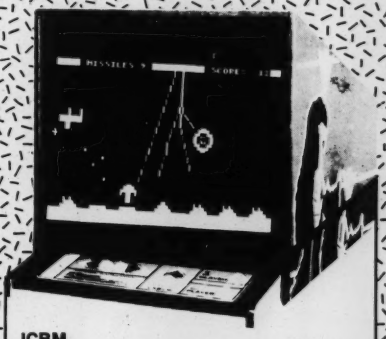

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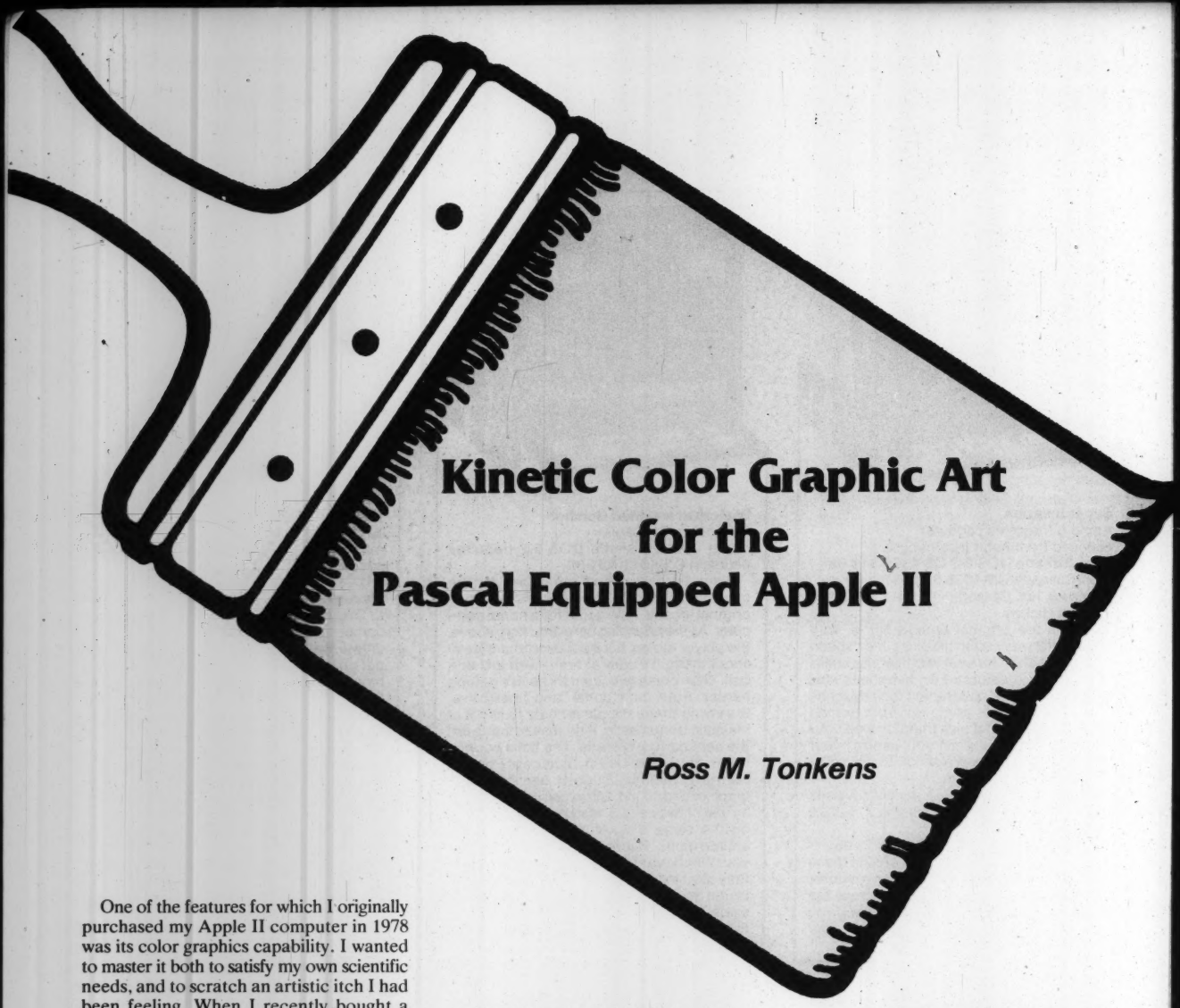


Kinetic Color Graphic Art for the Pascal Equipped Apple II

Ross M. Tonkens

One of the features for which I originally purchased my Apple II computer in 1978 was its color graphics capability. I wanted to master it both to satisfy my own scientific needs, and to scratch an artistic itch I had been feeling. When I recently bought a Language Card to teach myself Pascal, I likewise wanted to learn to exploit fully the Apple color graphics enhancements to standard UCSD Pascal.

The accompanying listing of the Apple/UCSD Pascal program, Stringart, resulted from a task I set for myself; I wanted to implement a well-defined graphics problem in Pascal. Stringart produces a fast, continuously evolving color graphics display according to parameters supplied interactively by the user. It is based on algorithms published elsewhere by Louis Ceza with a few new wrinkles of my own which allow the user to participate interactively in determining the general appearance of the patterns generated.

Ross M. Tonkens, M.D., Wilshire Heights Medical Group, 6221 Wilshire Blvd., Los Angeles, CA 90048.

Briefly here is the way the program works. The user is asked to choose the maximum number of colored lines to be displayed at one time on the monitor screen from 1 to 200. He next decides what display mode he wishes, continuous display or mass erasure.

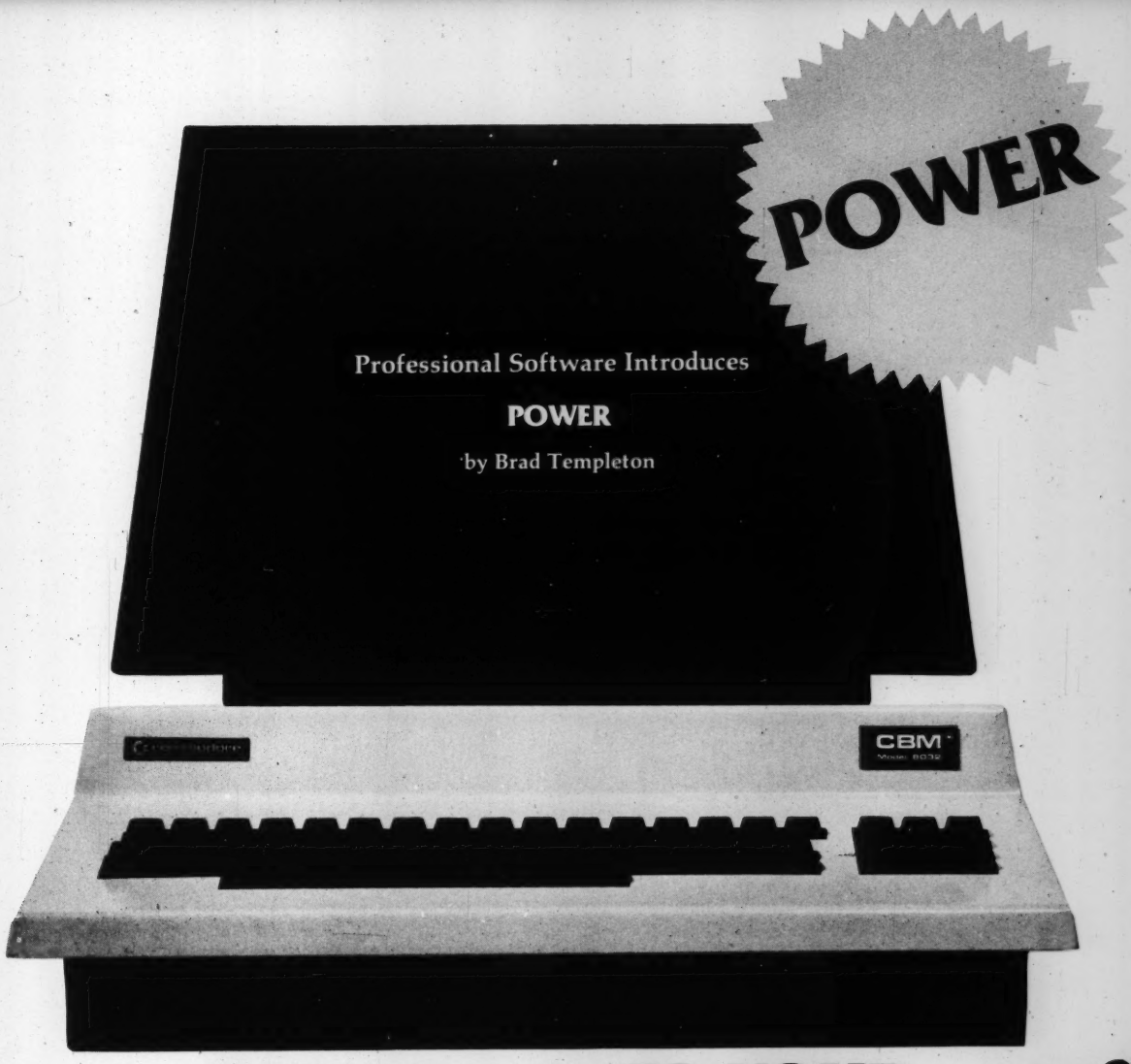
To clarify the distinction between these two modes, imagine you select 40 as the maximum number of lines you wish displayed on the monitor simultaneously. In the continuously evolving display mode the computer will draw 40 lines, then erase the first line before drawing the forty-first one. Thus never more than 40 lines are displayed at once. In the mass erasure mode the computer draws 40 lines, clears the entire screen, then starts over. Once again, never more than the user's specified 40 lines appear on the screen at once.

The computer picks a random color and uses it for a random number of lines. It then selects a new random color and uses it for a new random number of lines. The first line drawn has random end points. The second line has end points equal to those of the first plus a random offset value. This offset value is used for a random number of lines, then changed, and the new offset value used for a new random number of lines. If the end of a line would be off the video screen, that end point is reflected back into the view field.

Sound complicated? It really isn't, and a study of the accompanying commented Pascal listing should clear up any questions.

You don't have to understand the algorithms, though, to enjoy the results (See photographs).

So type in the program, and begin to experiment. The end result is a mesmerizing, continuously evolving kaleidoscope of Apple high resolution color through the interplay of user selected and randomly generated parameters. □



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About Variables

Great care was taken during program design to avoid side effects by minimizing the use of global variables. Whenever practical, values are passed to (and from) procedures and to functions as parameters. Where a local variable represents a global counterpart locally, that local variable is given a name similar to its global counterpart (e.g., ITERATION and ITERAYSHUN). While this practice is somewhat wasteful of memory, it avoids major debugging headaches caused by unforeseen side effects of procedures and functions.

TYPE COORDINATE

Purists would argue that a record for each line would be a more appropriate structure for storage of endpoints than a multidimensional array:

```
RECORD
  ONEEND      : ENDPOINT;
  THEOTHEREND : ENDPOINT
END
```

where TYPE ENDPOINT = PACKED ARRAY [X..Y] of INTEGER

FUNCTION RNDOM(F1,F2:INTEGER):INTEGER

This function, when invoked with two integer values, F1 and F2, returns a pseudo random integer between F1 and F2 inclusive.

FUNCTION READPIXEL(XY:CHAR;
N,I:INTEGER):INTEGER

This function returns either the x or y coordinate of one (of two) ends of the Ith line. It reads this coordinate out of the multidimensional array, T, in which it is stored. T is indexed by XY, N, and I. XY can assume values "X" or "Y" for x or y coordinate. N is of type WHICHEND and can assume values 1 or 2 since each line has two ends. For I := 0 to the user-specified maximum number of lines, endpoints for the "Ith" line can be read from the array, T, with the READPIXEL function. READPIXEL is used within nested loops which step through the indices (FOR XY := X to Y, FOR N := 1 to 2) of the Ith line to read coordinates out of the array, T, so they can be manipulated.

PROCEDURE SETUP(XY:CHAR; I:INTEGER);

This procedure initializes multidimensional arrays, T and DLTA, storing legal random values in the zeroth element. When invoked from within INITIALIZE (below), SETUP chooses random coordinates for the first line to which successive increments will be added by COMPUTECOORD (below). SETUP, when called from within DELTA (below), however, chooses a new set of random increment values to be added to successive line endpoints.

```
{*****************************************************************************
*THIS PROGRAM GENERATES A CONTINUOUSLY EVOLVING KINETIC COLOR GRAPHIC *
*DISPLAY.  IT IS DESIGNED TO RUN IN THE APPLE II/UCSD OPERATING SYSTEM*
*SYSTEM ENVIRONMENT.  ATTEMPT HAS BEEN MADE, AS MUCH AS POSSIBLE, TO  *
*ISOLATE THE IMPLEMENTATION SPECIFIC DETAILS.  THE CORE ALGORITHMS ARE*
*VALID FOR ANY ENVIRONMENT.                                           *
*                                                                     *
*THE PROGRAM COULD BE EASILY EXPANDED TO ALLOW USER PARTICIPATION     *
*EITHER PROSPECTIVELY THROUGH SLELCTION OF PAROMETERS TO BE USED IN   *
*EXECUTION OR IN REAL TIME THROUGH JOY STICK INPUT.                   *
*                                                                     *
*INSPIRED BY AN ARTICLE BY LOUIS CESA IN 'BYTE', VOL 5, NOVEMBER, 1980*
*PP. 62-63.                                                          *
*****************************************************************************}
{*$S+*}

PROGRAM STRINGART;

USES TURTLEGRAPHICS, APPLESTUFF;

CONST

CLRSCRN = 12;
MINX = 0; MAXX = 279;  (*THESE ARE CONSTRAINTS OF THE *)
MINY = 0; MAXY = 191;  (*THE APPLE II GRAPHICS DISPLAY*)
NOCOLOR = 0; WHITE  = 7;
LOCOLOR = 1; HICOLOR = 5;
MINCNT = 0; MAXCNT = 50;   (*MAX # OF ITERATIONS OF A GIVEN COLOR*)
MINDELTA = -15; MAXDELTA = 15;  (*LIMITS ON COORDINATE INCREMENTS*)
LOKOUNT = 0; HIKOUNT = 50;  (*MAX# OF ITERATIONS OF A GIVEN DELTA*)
ITERLIM = 200;          (*MAX # OF ITERATIONS BEFORE ERASURE BEGINS*)

TYPE

XYTYPE = 'X'..'Y';
ABTYPE = 'A'..'B';
WHICHEND = 1..2;
COLOURTYPE = NOCOLOR..WHITE;
OLDCOLOURTYPE = NOCOLOR..HICOLOR;
COORDINATE = ARRAY['X'..'Y',WHICHEND,0..ITERLIM] OF INTEGER;
INCREMENT  = ARRAY['A'..'B',WHICHEND] OF MINDELTA..MAXDELTA;
OLDCOLOR   = ARRAY[1..ITERLIM] OF OLDCOLOURTYPE;


VAR

COLORCOUNT  : MINCNT..MAXCNT;   (*COUNTS # OF LINES OF A GIVEN COLOR *)
DELTACOUNT  : LOKOUNT..HIKOUNT; (*COUNTS # OF LINES OF A GIVEN DELTA *)
T           : COORDINATE;       (*MULTIDIM ARRAY TO STORE COORDINATES*)
DLTA        : INCREMENT;
COLR        : COLOURTYPE;
OLDHUE      : OLDCOLOR;
MAXITERATION: 1..200;
ITERATION   : 1..201;           (*201 BECAUSE ITERATION BECOMES 201  *)
                                (*BEFORE 'ROLL OVER'                 *)
CH          : CHAR;
FLAG,
CONTINUOUS,
PENOFF,
THATSALL    : BOOLEAN;


FUNCTION RNDOM(F1,F2:INTEGER):INTEGER;

(*GENERATES A PSEUDO RANDOM # BETWEEN F1 & F2 INCLUSIVE*)

(*VALUES ARE NOT EVENLY DISTRIBUTED, BUT FOR THIS      *)
(*APPLICATION IT'S GOOD ENOUGH AND MUCH FASTER THAN THE*)
(*ALGORITHM TO PRODUCE A MORE EVENLY DISTRIBUTED SAMPLE*)

BEGIN(*RNDOM*)
 RNDOM:= F1 + RANDOM MOD(F2 - F1 + 1)
END(*RNDOM*);



FUNCTION READPIXEL(XY:CHAR; N,I:INTEGER):INTEGER;

(*READS A SET OF COORDINATES OUT OF MULTIDIM ARRAY 'T' *)

BEGIN(*READPIXEL*)
 READPIXEL:= T[XY,N,I]
END(*READPIXEL*);



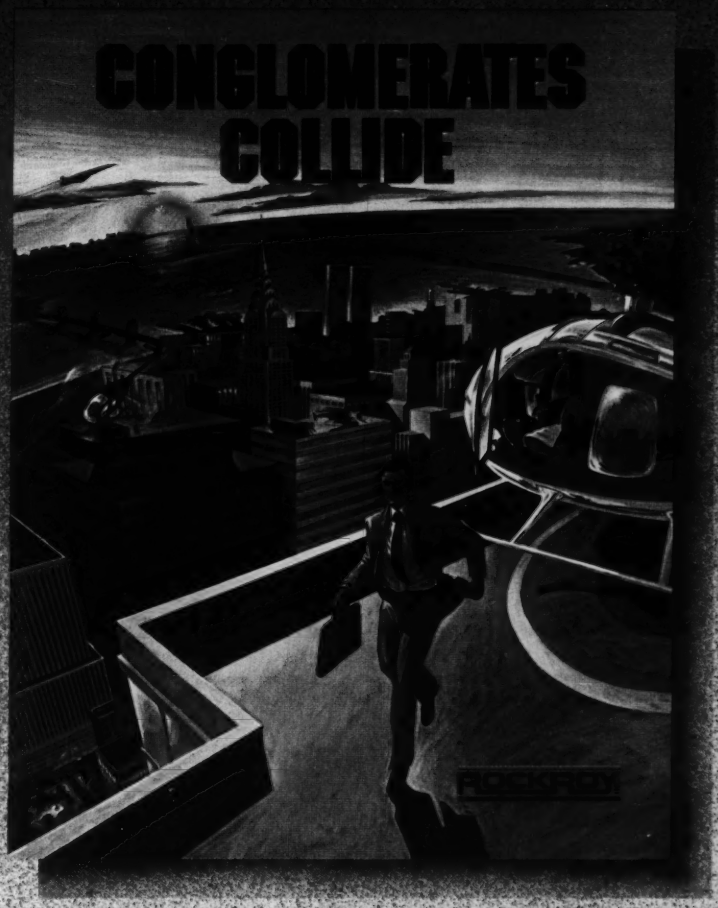

PROCEDURE SETUP(XY:CHAR; I:INTEGER);

(*INITIALIZES ARRAYS*)

VAR

N     : WHICHEND;


BEGIN(*SETUP*)
 FOR N:= 1 TO 2 DO
  CASE XY OF
              'A','B': DLTA[XY,N]:= RNDOM(MINDELTA,MAXDELTA);
                  'X': T[XY,N,I] := RNDOM(MINX,MAXX);
                  'Y': T[XY,N,I] := RNDOM(MINY,MAXY)
  END(*CASE*)
END(*SETUP*);
```



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PROCEDURE COMPUTECOORD
(ITERAYSHUN:INTEGER)

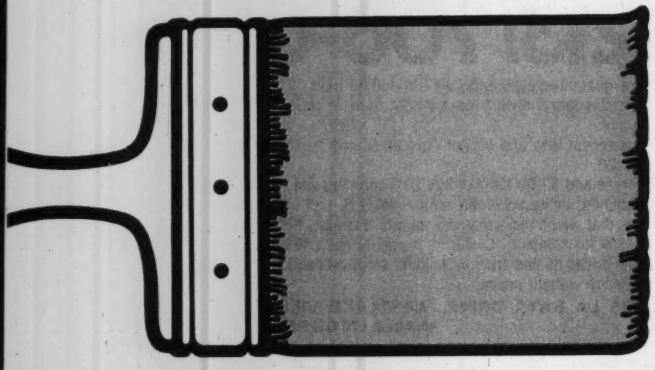
This procedure takes previous line endpoints, adds the selected increments to them, and stores the new endpoints back in the multidimensional array, T. It checks that the new endpoints are within the screen boundaries by invoking the procedure, BOUNDARY.

PROCEDURE DELTA

DELTA selects a random number of lines (DELTACOUNT) for which a given set of endpoint increment values will be repeated. It then decrements DELTACOUNT after each line until, when DELTACOUNT = 0, new increments are selected (by invoking SETUP), along with a new DELTACOUNT.

PROCEDURE BOUNDARY(VAR T,D:INTEGER;
MIN,MAX:INTEGER)

This tests the new line endpoints generated by COMPUTECOORD for legality (Do they fall within the screen?), and reflects illegal endpoints back within the screen boundaries.



```
PROCEDURE COMPUTECOORD(ITERAYSHUN:INTEGER);
(*ADDS DELTA TO PREVIOUS COORDINATE AND PLACES NEW VALUE IN T*)
VAR
XORY          : XYTYPE;
WITCHEND      : WHICHEND;


    PROCEDURE DELTA;
    (*DECREMENTS DELTACOUNTER AND SELECTS NEW DELTA ON 0 COUNT *)
    VAR
    AORB        : ABTYPE;

   BEGIN(*DELTA*)
    IF DELTACOUNT = 0
     THEN
      BEGIN
       FOR AORB:= 'A' TO 'B' DO
        SETUP(AORB,ITERAYSHUNR);
       DELTACOUNT:= RNDOM(LOKOUNT,HIKOUNT)
      END
     ELSE
      DELTACOUNT:= DELTACOUNT - 1
   END(*DELTA*);


    PROCEDURE BOUNDARY(VAR T,D:INTEGER; MIN,MAX:INTEGER);
    (*KEEPS LINES WITHIN SCREEN BOUNDS BY 'FOLDING BACK'*)
    (*LINES WHICH EXTEND OFF THE SCREEN WITHOUT CLIPPING*)
    BEGIN(*BOUNDARY*)
     IF (T < MIN) OR (T > MAX)
      THEN
       BEGIN
        T:= T - 2 * D;
        D:= -D
       END
    END(*BOUNDARY*);


BEGIN(*COMPUTECOORD*)
 DELTA;
 FOR XORY:= 'X' TO 'Y' DO
  FOR WITCHEND:= 1 TO 2 DO
   IF XORY = 'X'
    THEN
     BEGIN
      TCXORY,WITCHEND,ITERAYSHUN]:= TCXORY,WITCHEND,ITERAYSHUN - 1]
       + DLTAC'A',WITCHEND];
      BOUNDARY(TCXORY,WITCHEND,ITERAYSHUN],
                DLTAC'A',WITCHEND],MINX,MAXX)
     END
    ELSE
     BEGIN
      TCXORY,WITCHEND,ITERAYSHUN]:= TCXORY,WITCHEND,ITERAYSHUN - 1]
       + DLTAC'B',WITCHEND];
      BOUNDARY(TCXORY,WITCHEND,ITERAYSHUN],
                DLTAC'B',WITCHEND],MINY,MAXY)
     END
END(*COMPUTECOORD*);
```

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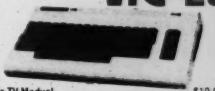

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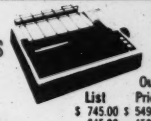

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TERMINALS

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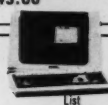

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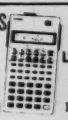

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CIRCLE 230 ON READER SERVICE CARD

PROCEDURE DRAW

This is the master line drawing routine. First it checks to see which mode (continuous or mass erasure) is set through the Boolean flag, CONTINUOUS. In the continuous drawing mode the procedure first erases the oldest displayed line before drawing a new one. The Boolean variable, FLAG, is set to FALSE until the user-specified number of lines has been drawn. Thus, until FLAG becomes TRUE no lines can be erased. DRAW contains a mechanism for "wrap around" when the highest line number has been reached, and the first element of the line storage array must be accessed again. It is within DRAW that the distinction between continuous display and mass erasure modes is recognized.

PROCEDURE COLOR(IT:INTEGER)

COLOR selects a random high resolution color and a random number of lines to be drawn with that color (COLORCOUNT). It then decrements COLORCOUNT until, at COLORCOUNT = 0, a new random high resolution color is selected along with a new COLORCOUNT, and the whole process starts over.

PROCEDURE LINE(COLER,ITER:INTEGER)

LINE uses READPIXEL to transfer the endpoint coordinates of lines to the actual graphics routines which then draw them.

PROCEDURE ERASELINE

This procedure selects the proper "shade" of black to erase a previous line depending on what color the line was. (This is necessary because of the unusual way in which the Apple displays high resolution colors). It then invokes LINE to draw the previous line in black, thus erasing it selectively. ERASELINE is used in the continuous display mode only.

```
PROCEDURE DRAW;
(*MASTER DRAWING ROUTINE*)
VAR
ENDPOINT      : WHICHEND;
XXYY          : XYTYPE;

    PROCEDURE COLOR(IT:INTEGER);
    (*DECREMENT COLORCOUNTER AND SELECT NEW COLOR ON 0 COUNT*)
    BEGIN(*COLOR*)
     IF COLORCOUNT = 0
      THEN
       BEGIN
        COLR:= RNDOM(LOCOLOR,HICOLOR);
        COLORCOUNT:= RNDOM(MINCNT,MAXCNT)
       END
      ELSE
       COLORCOUNT:= COLORCOUNT - 1;
     OLDHUE[IT]:= COLR
    END(*COLOR*);

 PROCEDURE LINE(COLER,ITER:INTEGER);
 (*FINDS ENDPOINTS AND ACTUALLY DRAWS OR ERASES A LINE*)
 VAR
 X,Y           : ARRAY[1..2] OF INTEGER;

 BEGIN(*LINE*)
  FOR ENDPOINT:= 1 TO 2 DO
   BEGIN
    X[ENDPOINT]:= READPIXEL('X',ENDPOINT,ITER);
    Y[ENDPOINT]:= READPIXEL('Y',ENDPOINT,ITER)
   END;
  PENCOLOR(NONE);
  MOVETO(X[1],Y[1]);
  CASE COLER OF
                0: PENCOLOR(BLACK);
                1: PENCOLOR(WHITE);
                2: PENCOLOR(GREEN);
                3: PENCOLOR(VIOLET);
                4: PENCOLOR(ORANGE);
                5: PENCOLOR(BLUE);
                6: PENCOLOR(BLACK1);
                7: PENCOLOR(BLACK2)
  END(*CASE*);
  MOVETO(X[2],Y[2])
 END(*LINE*);


 PROCEDURE ERASELINE;
 (*SELECTS THE PROPER 'TYPE' OF BLACK TO ERASE A PREVIOUS LINE *)
 (*NECESSITATED BY THE PECULIAR WAY THE APPLE II DISPLAYS COLOR*)
 VAR
 ERASECOLOUR  : COLOURTYPE;

 BEGIN(*ERASELINE*)
  CASE OLDHUE[ITERATION] OF
                          0,1: ERASECOLOUR:= 0;
                          2,3: ERASECOLOUR:= 6;
                          4,5: ERASECOLOUR:= 7
  END(*CASE*);
  LINE(ERASECOLOUR,ITERATION)
 END(*ERASELINE*);


 BEGIN(*DRAW*)
  IF (FLAG = TRUE) AND (CONTINUOUS = TRUE)
   THEN
    ERASELINE;
  COMPUTECOORD(ITERATION);
  COLOR(ITERATION);
  IF PENOFF = FALSE
   THEN
    LINE(COLR,ITERATION);
  ITERATION:= ITERATION + 1;
  IF ITERATION > MAXITERATION
   THEN
    BEGIN
     FOR XXYY:= 'X' TO 'Y' DO
      FOR ENDPOINT:= 1 TO 2 DO
       T[XXYY,ENDPOINT,0]:= T[XXYY,ENDPOINT,MAXITERATION];
     ITERATION:= 1;
     FLAG:= TRUE;
     IF CONTINUOUS = FALSE
      THEN INITTURTLE
    END
 END(*DRAW*);
```

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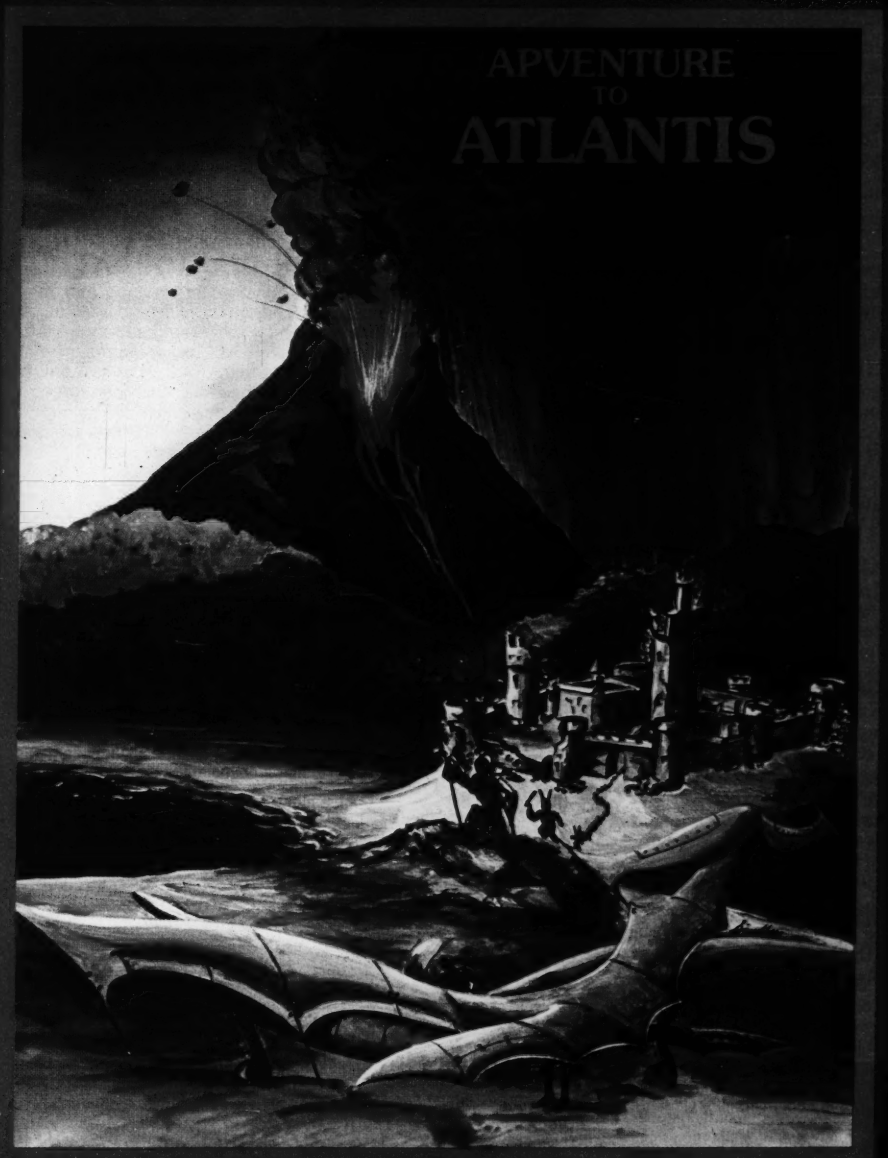

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CIRCLE 214 ON READER SERVICE CARD

Kinetic Art, continued...

PROCEDURE INITIALIZE

This procedure initializes all multidimensional arrays.

PROCEDURE MESSAGE

MESSAGE handles computer-user communication. It both prompts the user and accepts input from him. Exactly which message to display is determined by the Boolean software "switch," THATSALL.

PROCEDURE CENTERPRINT

This procedure accepts a string and displays it, centered on the screen.

PROGRAM STRINGART

First THATSALL, the abort flag, is cleared. The user is then prompted for the parameters within which he wishes the computer to generate art (MESSAGE). The pseudo random number generator is invoked (RANDOMIZE), and various multidimensional arrays holding line endpoints and increments are filled with random legal values (INITIALIZE). After the graphics mode is selected (INITTURTLE), drawing commences (DRAW) and continues until key closure is detected. The abort flag is then set. The goodbye message, selected by THATSALL, is assembled on the text screen while still in graphics mode (MESSAGE), and the text mode is reenabled (TEXTMODE), revealing the goodbye message already in place.

```
PROCEDURE INITIALIZE;
(*INITIALIZES VARIABLES AND ARRAYS*)
VAR
Z               : CHAR;

BEGIN(*INITIALIZE*)
 THATSALL:= FALSE;
 COLORCOUNT:= 0;
 DELTACOUNT:= 0;
 FOR Z:= 'X' TO 'Y' DO
  SETUP(Z,0);
 ITERATION:= 1;
 FLAG:= FALSE;
 PENOFF:= TRUE;
 REPEAT
  DRAW
 UNTIL FLAG = TRUE;
 FLAG:= FALSE;     (*ITERATION ALREADY = 1 AGAIN FROM 'DRAW'*)
 PENOFF:= FALSE
END(*INITIALIZE*);

  PROCEDURE MESSAGE;

  (*TAKES CARE OF ALL USER TEXT I/O BOTH ON ENTRY AND ON EXIT*)

  VAR

  X,Y             : INTEGER;
  MSSG            : STRING;

      PROCEDURE CENTERPRINT;

    (*CENTERS A LINE OF TEXT*)

    VAR

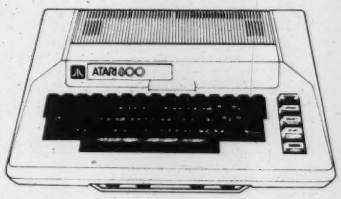
    X             : INTEGER;


    BEGIN(*CENTERPRINT*)
     X:= (40 - LENGTH(MSSG)) DIV 2;
     GOTOXY(X,Y);
     WRITELN(MSSG)
    END(*CENTERPRINT*);

  BEGIN(*MESSAGE*)
   IF THATSALL
    THEN
     BEGIN
      WRITE(CHR(CLRSCRN));
      MSSG:= 'THATS ALL!';
      Y:= 12;
      CENTERPRINT
     END
    ELSE
     BEGIN
      REPEAT
       MSSG:= '****STRING ART****';
       Y:= 12;
       CENTERPRINT;
       X:= 0; Y:= Y + 8;
       GOTOXY(X,Y);
       WRITE('NUMBER OF ITERATIONS?  (1 TO ',ITERLIM,')');
       READLN(MAXITERATION)
      UNTIL (MAXITERATION >= 1) AND (MAXITERATION <= ITERLIM);
      WRITE(CHR(CLRSCRN));
      REPEAT
       X:= 0; Y:= 10;
       GOTOXY(X,Y);
       WRITELN('SELECT EITHER:');
       X:= 2; Y:= Y + 2;
       GOTOXY(X,Y);
       WRITELN('<1> CONTINUOUSLY EVOLVING DISPLAY');
       X:= 2; Y:= Y + 2;
       GOTOXY(X,Y);
       WRITE('<2> ERASE DISPLAY EVERY ',MAXITERATION,' LINES');
       READ(CH)
      UNTIL (CH = '1') OR (CH = '2');
      CASE CH OF
                  '1'    : CONTINUOUS:= TRUE;
                  '2': CONTINUOUS:= FALSE
      END(*CASE*);
      WRITE(CHR(CLRSCRN));
      MSSG:= 'PRESS ANY KEY ONCE TO CONTINUE';
      Y:= 10;
      CENTERPRING;
      MSSG:= 'AFTER THAT ANY KEYPRESS WILL ABORT';
      Y:= 12;
      CENTERPRINT;
      REPEAT UNTIL KEYPRESS;
      READ(CH);
      WRITE(CHR(CLRSCRN));
      MSSG:= 'ONE MOMENT, PLEASE';
      Y:= 10;
      CENTERPRINT;
      MSSG:= 'INITIALIZING MULTIDIMENSIONAL ARRAYS';
      Y:= 12;
      CENTERPRINT
     END
  END(*MESSAGE*);

  BEGIN(*MAIN PROGRAM 'STRINGART'*)
   MESSAGE;
   RANDOMIZE;
   INITIALIZE;
   INITTURTLE;
   REPEAT
    DRAW
   UNTIL KEYPRESS;
   THATSALL:= TRUE;
   MESSAGE;
   TEXTMODE
  END(*MAIN PROGRAM 'STRINGART'*).
```

Atari SOFTWARE



Air Traffic Controller

In this popular, fast-moving simulation you must successfully control the flight paths of 27 aircraft as they take off, land and fly over your airspace. You give orders to change altitude, turn, maintain a holding pattern, approach and land at two airports. With five different airport configurations and variable skill levels, you won't easily tire of this absorbing and instructive simulation. Cassette CS-7004 $14.95.

Original Adventure

Only the brave enter the Colossal Cave, and only the clever survive. The entire evil cast of this classic game, from deadly dragon to nasty dwarf, will try to stop your quest for treasures. Using English commands, you explore the cave, travel through more than 100 locations, gather treasures, and attempt to think your way out of dangerous situations. Every aspect of the game is faithfully reproduced from the Original Adventure born on large computer systems. For weary travelers, there is even a SAVE GAME feature. Add this classic to your software collection. Order CS-7504 for disk $24.95, CS-7009 for cassette $19.95.

*Dominoes

Take on your computer at a game of draw dominoes. With options for repeating or alternating draw, **Dominoes** gives the game player a tough opponent who's always ready. From Thorn/EMI. Order cassette CS-7007. $11.95.

*Cribbage

Can you be the first to peg twice around the board? Your computer will put up a tough fight in this head-to-head game of cribbage. A graphic display of board and cards highlight this game of skill. From Thorn/EMI. Order cassette CS-7008. $11.95.

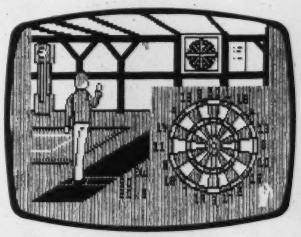
*Tilt

A favorite craze for years, the familiar wood labyrinth that tilts in all directions has entered the computer age. One or two players attempt to navigate balls through a maze and into scoring holes. With nine skill levels and nine speeds, **Tilt** will provide hours of fun. And, since each player can use a different skill level, **Tilt** is ideal for family play. From Thorn/EMI. Order cassette CS-7013 $11.95.

*Pool

Put a games room in your computer. Old pros and beginners alike will thrill to the challenge and realism of **Pool**. From the satisfying click of a tough combination shot to the acccuracy required for a three-cushion bank, **Pool** has it all. You control the angle and force of your stroke, then watch the object ball speed toward the pocket. It's so real you can almost feel the felt.

There is a practice mode for one player, and 8-Ball and Tournament Pool for two. Take a break with **Pool** today. From Thorn/EMI. Order cassette CS-7010 $14.95.



*Darts

Enter the pub, grab a pint of lager and a handful of darts, then try for a bull's eye in this amazing graphic game. One or two players can go at it, testing their aim at ten skill levels. Whether you want to throw a few, or just show your friends what the Atari computer can do, **Darts** is an ideal addition to your software library. This is Britain's most popular Atari game from Thorn/EMI. Order cassette CS-7011 $14.95.

*Billiards

This captivating British game is played with three balls on a standard pool table. Each player attempts to score by sinking a shot or hitting two balls with his cueball. From Thorn/EMI. Order cassette CS-7012 $14.95.

*Snooker

A tough British Game using 26 balls requiring the eye of sharpshooter and the strategy of a chess master. From Thorn/EMI. Not available on cassette.

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Trucker

This program simulates coast-to-coast trips by an independent trucker hauling various cargos.

If all goes well, you can obey the speed limits, stop for eight hours of sleep each night and still meet the schedule. Bad weather, road construction or flat tires may put you behind schedule. You may try to increase your profit by skimping on sleep, driving fast or carrying an overweight load. Not available on cassette.

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An Apple Slide Show

Mark Harris

David Lubar's article "Apple Picture Packer" in the June '81 issue of *Creative Computing* showed a way to compress Apple II high-resolution graphics for disk storage. The method is best suited for images with broad areas of single colors, a common situation in graphics. I would like to describe how to further compress a special class of pictures.

I teach Mathematics at Appalachian State University and use the Apple as a classroom tool; my most frequent use of graphics is in displaying the graph of a function or relation. A typical graph consists of two coordinate axes, a curve plotting one variable against another, and a little labeling, all against a black background. Since relatively few of the 280 x 180 pixels are being used, it is desirable to store the graph by describing only the pixels in use. With this in mind I wrote the machine language subroutines GR and LOADGR which store and load compact versions of a graph. I shall describe the strategy used in these programs a little later.

How useful are these programs? An average graph now takes only three or four sectors of disk storage, as compared to 32 for straight storage of a whole graphics page. Because of the modest space requirements, loading of the graphs is very fast, and several can be put into Apple memory at the same time. I can queue about twenty graphs in RAM and cycle through them at a fraction of a second per graph (pausing when I want to). This is the idea behind the Basic program Slide Show (Listing 1).

SLIDE SHOW

```
10 AD =  - 16300
20  HOME : VTAB 10
30 START = 24576: REM  START OF LOADGR SUBROUTINE
40 D$ =  CHR$ (4): REM  CONTROL D
50 S = 1
60  DIM A(20),B(20)
70  PRINT D$;"BLOAD LOADGR.OBJ"
80  PRINT "I WILL DISPLAY GRAPHS STORED BY THE"
90  PRINT
100  PRINT "GR.OBJO PROGRAM AS NAME1,NAME2,..."
110  PRINT
120  INPUT "WHAT IS THE NAME? ";G$
130  PRINT : INPUT "HOW MANY GRAPHS? ";N
140 A(1) = START + 80: REM  START OF FIRST COMPACT GRAPH
150  FOR I = 1 TO N
160  PRINT D$;"BLOAD ";G$;I;",A";A(I)
170 L =  PEEK (43616) +  PEEK (43617) * 256: REM  LENGTH OF BLOADED PROGRAM.
180 A(I + 1) = A(I) + L: REM  COMPUTE STARTING ADDRESS FOR NEXT GRAPH
190  NEXT
200  FOR I = 1 TO N
210 B(I) =  INT (A(I) / 256): REM  MSB
220 A(I) = A(I) - B(I) * 256: REM  LSB
230  NEXT
240  HGR2 : HGR
250  POKE  - 16302,0: REM  FULL SCREEN GRAPHICS
260 PG = 1:I = 1: GOSUB 350: REM  LOAD 1ST GRAPH ON PAGE 1
270 PG = 2:I = 2: GOSUB 350: REM  LOAD 2ND GRAPH ON PAGE 2
280 X =  FRE (0): REM  A LITTLE HOUSE-CLEANING
290  GET A$: IF A$ = "S" THEN  TEXT : HOME : END
300  IF A$ =  CHR$ (27) THEN I = I + 1: GOSUB 320: REM  CHECK FOR ESC KEY
310  GOTO 280
320 AD = AD + S: POKE AD,0:S =  - S: REM  FLIPS PAGE
330 PG = (3 + S) / 2
340  IF I > N THEN I = 1
350  POKE 250,B(I): POKE 249,A(I): REM  SET UP ADDRESS OF NEXT GRAPH FOR LOADGR
360  IF PG = 1 THEN  POKE 252,32: CALL START: RETURN
370  POKE 252,64: CALL START: RETURN
```

Listing 1. A sample Applesoft program that displays compressed graphs.

Mark Harris, Math Dept, Appalachian State University, Boone, NC 28608.

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Slide Show, continued...

About Slide Show

Use of this Applesoft program requires that several graphs first be BSAVEd under the same name followed by successive numbers, e.g. GRAPH1, GRAPH2, etc. This is done with the GR routine. Slide Show will ask for the name and number of graphs, then load them starting at address $6050 (the subroutine LOADGR is placed at $6000). Next the first two graphs are placed in hi-res pages one and two, and page one is displayed. When the ESC key is depressed, the Apple switches to page two. GRAPH3 is transferred by the LOADGR routine to page one, all done neatly behind the scenes. When ESC is hit again, GRAPH3 is displayed instantly. This loading on the hidden page continues through the entire list of graphs and then starts back with GRAPH1. The graphs appear just about as fast as the ESC key can be depressed. When you're done, just hit the "S" key.

The GR Subroutine

To compress and save a graph using the GR subroutine (Listing 2), first get the graph of your choice on hi-res page one. (I use standard HPLOTing to draw the graph and use the DOS Tool Kit "HRCG" program to label it.) Then get back to the TEXT and type BRUN GR (assuming you have saved the GR program on disk). A message giving the starting address and length of your now-compressed graph will appear on the screen. If these numbers were $0C00 and $FC, typing BSAVE GRAPH4,A$C00,L$FC would save the graph on disk under the name GRAPH4.

```
SOURCE FILE: GR
----- NEXT OBJECT FILE NAME IS GR.OBJ
0C00:            1          ORG  $0C00
00F9:            2 TBL      EQU  $F9   ;LOW BYTE OF TABLE ADDRESS
00FA:            3 TBH      EQU  $FA
00FB:            4 PGL      EQU  $FB
00FC:            5 PGH      EQU  $FC   ;CURRENT PAGE
FDED:            6 COUT     EQU  $FDED
FDDA:            7 PRBYTE   EQU  $FDDA
0C00:A2 00       8          LDX  #0
0C02:86 FB       9          STX  PGL
0C04:86 F9      10          STX  TBL
0C06:A9 20      11          LDA  #$20  ;1ST PG OF HRES GRAPHICS
0C08:85 FC      12          STA  PGH
0C0A:A9 0D      13          LDA  #$0D
0C0C:85 FA      14          STA  TBH   ;TABLE BEGINS AT $0D00
0C0E:           15 ;A ZERO BYTE MARKS END OF PAGE
0C0E:           16 ;TABLE ORGANIZATION:
0C0E:           17 ;DATA,ADRS,DTA,ADRS,...,ZBYTE,...
0C0E:A0 00      18 NWPG    LDY  #0
0C10:B1 FB      19 ZCHK    LDA  (PGL),Y
0C12:F0 0B      20          BEQ  CT
0C14:81 F9      21          STA  (TBL,X)  ;STORE NONZERO DATA
0C16:20 34 0C   22          JSR  PTR
0C19:98         23          TYA
0C1A:81 F9      24          STA  (TBL,X)  ;STORE LOW BYTE OF ADRS
0C1C:20 34 0C   25          JSR  PTR
0C1F:C8         26 CT      INY
0C20:D0 EE      27          BNE  ZCHK
0C22:A9 00      28          LDA  #0
0C24:81 F9      29          STA  (TBL,X)
0C26:20 34 0C   30          JSR  PTR
0C29:E6 FC      31          INC  PGH
0C2B:A5 FC      32          LDA  PGH
0C2D:C9 40      33          CMP  #$40
0C2F:F0 0A      34          BEQ  DONE
0C31:4C 0E 0C   35          JMP  NWPG  ;CHECK NEW PAGE
0C34:E6 F9      36 PTR     INC  TBL   ;SBR TO MOVE POINTER
0C36:D0 02      37          BNE  RET
0C38:E6 FA      38          INC  TBH
0C3A:60         39 RET     RTS
0C3B:A0 00      40 DONE    LDY  #0
0C3D:B9 59 0C   41 FTCH    LDA  MSG,Y    ;GET CHAR FOR MESSAGE
0C40:F0 07      42          BEQ  LGTH
0C42:           43 ;ZERO MARKS END OF MESSAGE:
0C42:20 ED FD   44          JSR  COUT
0C45:C8         45          INY
0C46:4C 3D 0C   46          JMP  FTCH
0C49:A5 FA      47 LGTH    LDA  TBH      ;FIND LENGTH OF TABLE
0C4B:38         48          SEC
0C4C:E9 0D      49          SBC  #$0D
0C4E:20 DA FD   50          JSR  PRBYTE
0C51:A5 F9      51          LDA  TBL
0C53:20 DA FD   52          JSR  PRBYTE
0C56:4C D0 03   53          JMP  $3D0     ;GO TO BASIC
0C59:8D 8D 8D   54 MSG     DFB  $8D,$8D,$8D
0C5C:A0 A0 A0   55          ASC  "              FINISHED."
0C5F:A0 A0 C6
0C62:C9 CE C9
0C65:D3 C8 C5
0C68:C4 AE
0C6A:8D 8D      56          DFB  $8D,$8D
0C6C:A0 A0 A0   57          ASC  "              ADDRESS = $0D00"
0C6F:A0 A0 C1
0C72:C4 C4 D2
0C75:C5 D3 D3
0C78:A0 8D A0
0C7B:A4 B0 C4
0C7E:B0 B0
0C80:8D 8D      58          DFB  $8D,$8D
0C82:A0 A0 A0   59          ASC  "              LENGTH = $"
0C85:A0 A0 CC
0C88:C5 CE C7
0C8B:D4 C8 A0
0C8E:8D A0 A4
0C91:00         60          DFB  0

### SUCCESSFUL ASSEMBLY: NO ERRORS
```

Listing 2. This machine language routine compresses hi-res data.

Packed Thoughts

An Apple Slide Show and *Picture Packer Revisited* show two excellent and diverse extensions of the packing concept. By tackling a specific area of graphics, namely plotted functions, Mr. Harris has achieved not only an extraordinary compactness of data, but also a very fast display routine. This combination need not be limited to graphs, but could also be applied, in some cases, to animation. A series of line drawings could be rapidly cycled through the screen. To carry the idea a step further, if the data were placed on the screen with an Exclusive OR, objects could be moved across a background scene. I believe readers will find many applications for the programs created by Mr. Harris.

In *Picture Packer Revisited* (see page 116), Mr. Haley has taken a quantum leap beyond the original program. His approach is elegant, and the degree of compression is impressive. One slight extension readers might wish to try would be to append a routine that turns all $00 bytes of the picture to $80. This would have no effect on the picture since $00 and $80 both produce seven unset pixels on the screen. And with no $00 bytes in the picture, $00 could be used as a signal byte. In this way, there would be no need to check for a byte which might be data or might be a flag, and BEQ could be used in place of comparing the value against $FE. Beyond this, I almost feel Mr. Haley has taken the packing concept as far as it can go. But such speculation usually turns out to be wrong. Which brings up a personal note.

I want to thank readers who have the curiosity and drive to push a concept beyond its limits. There is great pleasure in seeing a better way, in hearing from someone who has made an imaginative leap or found a new approach. While there is nothing wrong with using a printed program as is, there can be great rewards in asking yourself "Is this program as good as it can be?" Someone is going to surprise us. But it really shouldn't be a surprise. I've come to expect innovation and excellence from you. Thanks.—D.L.

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How It Works

Each address in Apple memory consists of two bytes. The first byte is sometimes called the page number (not to be confused with the hi-res graphics pages) and the second byte gives the locations on that page. A hi-res picture occupies either memory $2000-$3FFF (hi-res page one) or $4000-5FFF (page 2). Hence a graphics page takes 32 pages of memory.

The GR program starts at the first memory page, say $2000, and finds the addresses and contents of all non-zero bytes on that page. Using a zero byte as a separator (we know it will never occur as a data byte under this scheme), the program moves on to the second page and so on up to the 32nd page. The storage format for each page is:

data byte, address byte, data byte, address byte, ... , zero byte.

Since we can keep track of the page byte and change it only when a zero byte is reached, we require only one byte for the address.

The efficiency of this method depends on the percentage of zero bytes on the graphics page. With the graphs I normally encounter, about 95% of the bytes are zero (corresponding to black background) and compact storage takes only about 10% of the original $2000 bytes. For a picture with no zero bytes, we would have a disaster; it would require more than twice the original space to store the same graph.

Other Uses

The Slide Show program illustrates one use of the LOADGR routine (Listing 3), but you may want to use it in other ways. For example, the following program puts a single graph on HGR page one and then quits:

Closing Comments

The programs listed here work well for compressing graphs which sparsely occupy an HGR page. It would be easy to change the programs to accommodate a background color other than black, but displaying staid mathematical curves against a violet page would be a little tacky.

The programs listed here work well for compressing graphs which sparsely occupy an HGR page.

```
SOURCE FILE: LOADGR
                    1 ###############################################################################
0000:               2 #
0000:               3 # SUBROUTINE LOADGR
0000:               4 #
0000:               5 # THIS SUBROUTINE CLEARS A HIGH-RES GRAPHICS PAGE (1 OR 2) AND LOADS A GRAPH
0000:               6 # WHICH HAS BEEN STORED BY THE GR.OBJ SUBROUTINE.
0000:               7 # TO CALL, THE PAGE # AND THE STARTING ADDRESS OF THE GRAPH MUST BE GIVEN.
0000:               8 # PAGE #: STORE $20 (FOR PAGE 1) OR $40 (FOR PAGE 2) IN PGH (DEFINED BELOW
0000:               9 # AS $FC).
0000:              10 # GRAPH ADDRESS: STORE LOW BYTE IN TBL ($F9), HIGH BYTE IN TBH ($FA).
0000:              11 #
                   12 ###############################################################################
----- NEXT OBJECT FILE NAME IS LOADGR.OBJ
6000:              13         ORG  $6000
00F9:              14 TBL     EQU  $F9
00FA:              15 TBH     EQU  $FA
00FB:              16 PGL     EQU  $FB
00FC:              17 PGH     EQU  $FC
6000:18            18         CLC
6001:A5 FC         19         LDA  PGH
6003:8D 4D 60      20         STA  ADR
6006:69 20         21         ADC  #$20      ;COMPUTE END ADDRESS OF GRAPHICS PAGE
6008:8D 4E 60      22         STA  ENDADR
600B:              23 # CLEAR PAGE TO BLACK:
600B:A0 00         24         LDY  #0
600D:84 FB         25         STY  PGL
600F:A9 00         26         LDA  #0
6011:91 FB         27 LOOP    STA  (PGL),Y
6013:C8            28         INY
6014:D0 FB         29         BNE  LOOP
6016:E6 FC         30         INC  PGH
6018:A6 FC         31         LDX  PGH
601A:EC 4E 60      32         CPX  ENDADR    ;END?
601D:D0 F2         33         BNE  LOOP
601F:AA            34         TAX            ;ZERO X REG
6020:AD 4D 60      35         LDA  ADR
6023:85 FC         36         STA  PGH
6025:A1 F9         37 LOAD    LDA  (TBL,X)
6027:F0 10         38         BEQ  CHPG      ;INCREASE HIGH BYTE IF NECESSARY
6029:20 46 60      39         JSR  PTR
602C:48            40         PHA
602D:A1 F9         41         LDA  (TBL,X)
602F:A8            42         TAY
6030:68            43         PLA
6031:91 FB         44         STA  (PGL),Y
6033:20 46 60      45         JSR  PTR
6036:4C 25 60      46         JMP  LOAD
6039:E6 FC         47 CHPG    INC  PGH
603B:A5 FC         48         LDA  PGH
603D:20 46 60      49         JSR  PTR
6040:CD 4E 60      50         CMP  ENDADR    ;END?
6043:D0 E0         51         BNE  LOAD
6045:60            52         RTS
6046:E6 F9         53 PTR     INC  TBL
6048:D0 02         54         BNE  RET
604A:E6 FA         55         INC  TBH
604C:60            56 RET     RTS
604D:              57 ADR     DS   1
604E:              58 ENDADR  DS   1

### SUCCESSFUL ASSEMBLY: NO ERRORS
```

Listing 3. A routine to restore the compressed graphs.

If you want to use Slide Show as part of a presentation to an audience, you may want to substitute a paddle button for the escape key to change graphs. This allows you to face the group and control the Apple from a distance. To make this change, just replace lines 290 and 300 with:

290 IF PEEK(49249) > 127 THEN I=I+1:GOSUB 320

Both Basic programs listed in this article call the LOADGR subroutine under the name LOADGR.OBJ, so either store it that way or change the program to agree with the name you choose.

Slide Show is designed for an Apple with 48K, but the other programs can be used with less memory.

After you are finished using Slide Show, it's a good idea to type the command "FP" to restore the computer to its usual good-natured self. □

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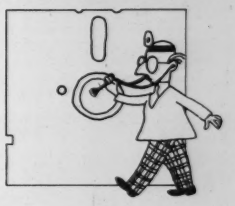

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PICTURE PACKER Revisited

Kenneth M. Haley

David Lubar's Apple Picture Packer 3.0 (*Creative Computing*, June, 1981, pp. 128-138) is a handy disk saving tool. After using it for a while, I became intrigued (as he did) with the question of whether the routine could be improved. Upon reviewing his method, several possible improvements occurred to me and I decided to try them out.

First of all (as Mr. Lubar suggests at the end of his article), the screen should be scanned in the order it appears rather than in ascending memory sequence. But more importantly, the screen should be scanned vertically instead of horizontally. There are only 40 bytes in a horizontal row compared with 192 bytes in each vertical column. So, vertical scanning improves the likelihood of finding the longer strings of recurring bytes. Furthermore, the odd-even alternating pattern that appears during horizontal scanning is eliminated. This avoids the necessity of multiple passes.

The other area I changed was the packing algorithm itself. There isn't a significant difference in actual savings here, but there are two advantages: 1) it is virtually impossible for a picture to expand in size, and 2) it is easier to code.

It works this way: Every byte in the original picture is copied to the packed picture until a string of four or more (up to 255) identical bytes is found. Each such string is replaced with the three-byte sequence: repeat-code, count, byte. For example:

01 02 03 04 05 06 06 06 06 06 06 06 07

would be packed as

01 02 03 04 05 05 05 FF 07 06 07

saving four characters. I used a hex "FE" for the repeat-code because it seems to be rare in hi-res pictures. If any string of repeat-codes is found in the original screen, it must always be replaced with the three-byte sequence even if it is only one byte long (this is the only way the packed picture could possibly increase in size). Fortunately that is not a big problem. In the 22 pictures I tested, I didn't find a single FE.

After coding the new packing and unpacking algorithms (HR.PACKER and HR.UNPACKER), I packed 22 pictures using both methods. The pictures I used are the ones found in Apple Contributed Software, Volumes 2 and 4.

Table 1 shows the number of bytes and sectors used by each method for each of the pictures. A total of 72 additional sectors were saved by HR.PACKER. That's an average of just over three additional sectors per picture—a significant improvement. Now I had enough room to put all 22 pictures, all the associated software, a copy of HR.UNPACKER, and SHOW (see Listing 1) all on one 16-sector diskette (see Figure 1). SHOW (Listing 1) is a simple Applesoft program to read, unpack, and display all 22 pictures.

Program Notes

Both HR.PACKER and HR.UNPACKER use hi-res page 1 ($2000-$3FFF) for the normal picture and hi-res page 2 ($4000-$5FFF) for the packed version. Both programs contain a considerable amount of code to do the vertical scanning. This is found between the "MAIN LINE" and "END OF JOB" comments in each source listing. Basically, it consists of four nested loops. Each column of the screen is scanned from bottom to top and the columns are scanned from right to left. It seems to me that it shouldn't be so cumbersome to do this, but I couldn't seem to improve on it (any suggestions, readers?).

Table 1.

Picture	Picture Packer 3.0 Bytes	Sectors	HR.PACKER Bytes	Sectors	Sectors Saved
MUSIC	1614	8	1637	8	0
WORLD MAP	4489	19	2173	10	9
TEQUILA	6944	29	5744	24	5
DOUBLE BESSEL FUNCTION	3220	14	2760	12	2
WLM SHAKESPEARE	6173	26	4770	20	6
UNCLE SAM	4502	19	2294	10	9
JOE SENT ME...	7895	32	7377	30	2
SPIRALLEL OGRAM	4221	18	3478	15	3
ROCKY RACCOON	6913	29	5910	25	4
CHARACTERS	2674	12	1987	9	3
DOLLAR	4643	20	4119	18	2
RANDOM LADY	6373	26	5470	23	3
LADY BE GOOD	6883	28	6187	26	2
MACROMETER	5791	24	5234	22	2
DIP CHIPS	6555	27	6443	27	0
TEX	5852	24	4764	20	4
SQUEEZE	4881	21	4786	20	1
THE TIME MACHINE	4957	21	2959	13	8
WINSTON CHURCHILL	6689	28	5968	25	3
HOPALONG CASSIDY	5647	24	5030	21	3
A GIRL'S BEST FRIEND	7220	30	6956	29	1
BABY JANE	5781	24	5764	24	0

Kenneth M. Haley, 5916 S. Kenton St., Englewood, CO 80111.

```
100  DATA MUSIC
110  DATA WORLD MAP
120  DATA TEQUILA
130  DATA DOUBLE BESSEL FUNCTION
140  DATA WLM SHAKESPEARE
150  DATA UNCLE SAM
160  DATA JOE SENT ME...
170  DATA SPIRALLELOGRAM
180  DATA ROCKY RACCOON
190  DATA CHARACTERS
200  DATA DOLLAR
210  DATA RANDOM LADY
220  DATA LADY BE GOOD
230  DATA MACROMETER
240  DATA DIP CHIPS
250  DATA TEX
260  DATA SQUEEZE
270  DATA THE TIME MACHINE
280  DATA WINSTON CHURCHILL
290  DATA HOPALONG CASSIDY
300  DATA A GIRL'S BEST FRIEND
310  DATA BABY JANE
320 D$ =  CHR$ (4)
330  PRINT D$;"BLOAD HR.UNPACKER"
340  HGR : POKE  - 16302,0
350  FOR I = 1 TO 22
360  READ X$
370  PRINT D$;"BLOAD ";X$;".PIC"
380  CALL 768
390  NEXT I
400  END
```

Listing 1.

```
A 002 HELLO
B 002 HR.UNPACKER
A 003 SHOW
B 008 MUSIC.PIC
B 010 WORLD MAP.PIC
B 024 TEQUILA.PIC
B 012 DOUBLE BESSEL FUNCTION.PIC
B 020 WLM SHAKESPEARE.PIC
B 010 UNCLE SAM.PIC
B 030 JOE SENT ME....PIC
B 015 SPIRALLELOGRAM.PIC
B 025 ROCKY RACCOON.PIC
B 009 CHARACTERS.PIC
B 018 DOLLAR.PIC
I 022 SLIDE SHOW 1
B 023 RANDOM LADY.PIC
B 026 LADY BE GOOD.PIC
B 022 MACROMETER.PIC
B 027 DIP CHIPS.PIC
B 020 TEX.PIC
B 020 SQUEEZE.PIC
B 013 THE TIME MACHINE.PIC
B 025 WINSTON CHURCHILL.PIC
B 021 HOPALONG CASSIDY.PIC
B 029 A GIRL'S BEST FRIEND.PIC
B 024 BABY JANE.PIC
I 022 SLIDE SHOW 2
```

Figure 1.

The remainder of the programs deal with the packing and unpacking logic as described above. The simpler packing method saves quite a bit of code here; so, even with additional code for vertical scanning, HR.PACKER turned out to be slightly shorter than Picture Packer 3.0 and HR.UNPACKER came out only slightly longer than Unpacker 3.0.

I retained Mr. Lubar's idea of using only relative branches, so the routines may be loaded into any available memory space. I also used the same page zero location for the end-of-table pointer ($00-$01). So the routines are used in precisely the same way as Mr. Lubar's are. □

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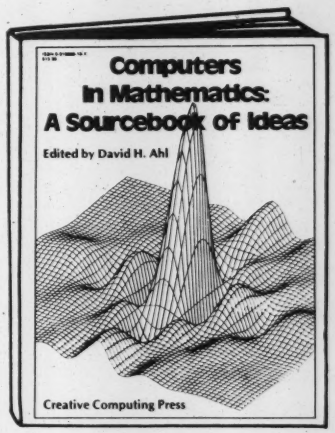

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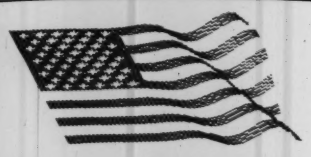

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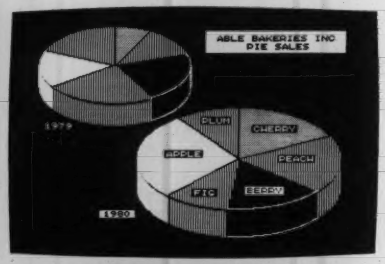

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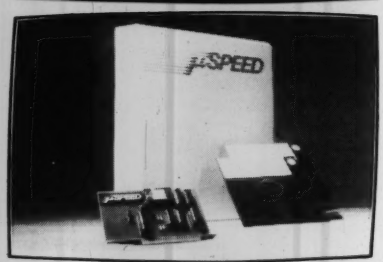

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Packer, continued...

```
HR.PACKER       VERSION: 1.0

----- NEXT OBJECT FILE NAME IS HR.PACKER.OBJ0
1000:                 2         ORG  $1000
                      3 ************************************************
1000:                 4 *-PROGRAM: HR.PACKER
1000:                 5 *-VERSION: 1.0
1000:                 6 *-WRITTEN BY: KEN HALEY
1000:                 7 *-DATE: 7/15/81
1000:                 8 *-HI-RES SCREEN DATA COMPACTION ROUTINE
1000:                 9 *- IDEA FROM PICTURE PACKER 3.0, DAVID LUBAR.  DESCRIBED
1000:                10 *- IN CREATIVE COMPUTING, JUNE, 1981, PP. 128-138.
                     11 ************************************************
0000:                12         DSECT           ; PAGE ZERO VARIABLES
0000:                13         ORG  $0         ; .
0000:00 00           14 TBPTR   DW   0          ; POINTER TO END OF PACKED PICTURE
0002:00 00           15 B2      DW   0          ; LOOP2 COUNTER
0004:00 00           16 B3      DW   0          ; LOOP3 COUNTER
0006:00 00           17 B4      DW   0          ; LOOP4 COUNTER
0008:00              18 PREVX   DFB  0          ; PREVIOUS BYTE IN SCREEN
0009:00              19 RPTCD   DFB  0          ; REPEAT CODE (WILL = '$FE')
000A:00              20 RPTCT   DFB  0          ; COUNT OF REPEATING BYTES
000B:00              21 FTSW    DFB  0          ; FIRST TIME SWITCH (MSB ON = YES)
000C:00              22 EOJSW   DFB  0          ; END OF JOB SWITCH (MSB ON = YES)
1000:                23         DEND            ; (END OF PAGE ZERO DEFINITIONS)
1000:                24 *-----INITIALIZATION
1000:A9 00           25         LDA  #$00       ; SET TBPTR = $4000.
1002:85 00           26         STA  TBPTR      ; .
1004:A9 40           27         LDA  #$40       ; .
1006:85 01           28         STA  TBPTR+1    ; .
1008:A9 FE           29         LDA  #$FE       ; SET RPTCD = $FE.
100A:85 09           30         STA  RPTCD      ; .
100C:A9 80           31         LDA  #$80       ; SET FTSW = YES.
100E:85 0B           32         STA  FTSW       ; .
1010:A9 00           33         LDA  #0         ; SET EOJSW = NO.
1012:85 0C           34         STA  EOJSW      ; .
1014:                35 *
1014:                36 *-----MAIN LINE
1014:A0 27           37         LDY  #39        ; SET Y = 39.
1016:                38 * (Y-REG NOW CONTAINS COLUMN NO.)
1016:                39 LOOP1   EQU  *
1016:A9 78           40         LDA  #$78       ; SET B2 = $2078.
1018:85 02           41         STA  B2         ; .
101A:A9 20           42         LDA  #$20       ; .
101C:85 03           43         STA  B2+1       ; .
101E:                44 LOOP2   EQU  *
101E:A5 02           45         LDA  B2         ; SUBTRACT $28 FROM B2.
1020:38              46         SEC             ; .
1021:E9 28           47         SBC  #$28       ; .
1023:85 02           48         STA  B2         ; .
1025:B0 02           49         BCS  L2A        ; .
1027:C6 03           50         DEC  B2+1       ; .
1029:                51 L2A     EQU  *
1029:A5 02           52         LDA  B2         ; SET B3 = B2 + $400.
102B:85 04           53         STA  B3         ; .
102D:A5 03           54         LDA  B2+1       ; .
102F:18              55         CLC             ; .
1030:69 04           56         ADC  #$4        ; .
1032:85 05           57         STA  B3+1       ; .
1034:                58 LOOP3   EQU  *
1034:A5 04           59         LDA  B3         ; SUBTRACT $80 FROM B3.
1036:38              60         SEC             ; .
1037:E9 80           61         SBC  #$80       ; .
1039:85 04           62         STA  B3         ; .
103B:B0 02           63         BCS  L3A        ; .
103D:C6 05           64         DEC  B3+1       ; .
103F:                65 L3A     EQU  *
103F:A5 04           66         LDA  B3         ; SET B4 = B3 + $2000.
1041:85 06           67         STA  B4         ; .
1043:A5 05           68         LDA  B3+1       ; .
1045:18              69         CLC             ; .
1046:69 20           70         ADC  #$20       ; .
1048:85 07           71         STA  B4+1       ; .
104A:                72 LOOP4   EQU  *
104A:A5 07           73         LDA  B4+1       ; SUBTRACT $400 FROM B4.
104C:38              74         SEC             ; .
104D:E9 04           75         SBC  #$4        ; .
104F:85 07           76         STA  B4+1       ; .
1051:18              77         CLC             ; (FORCE NEXT BRANCH)
1052:90 20           78         BCC  PRSB       ; PROCESS SCREEN BYTE.
1054:                79 NXT4    EQU  *
1054:A5 07           80         LDA  B4+1       ; B4 = B3?
1056:C5 05           81         CMP  B3+1       ; .
1058:D0 F0           82         BNE  LOOP4      ; NO, REPEAT LOOP4.
105A:                83 NXT3    EQU  *
```

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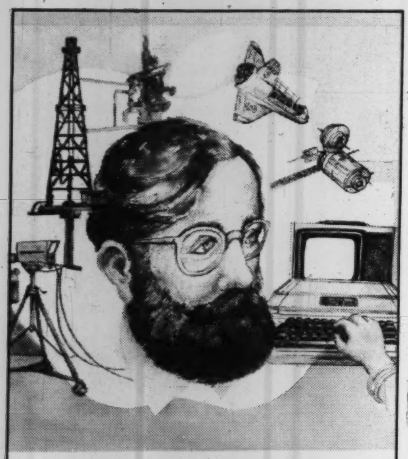

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CIRCLE 143 ON READER SERVICE CARD

Packer, continued...

```
105A:A5 04      84          LDA  B3         ; B3 = B2?
105C:C5 02      85          CMP  B2         ; .
105E:D0 D4      86          BNE  LOOP3      ; NO, REPEAT LOOP3.
1060:A5 05      87          LDA  B3+1       ; .
1062:C5 03      88          CMP  B2+1       ; .
1064:D0 CE      89          BNE  LOOP3      ; .
1066:           90 NXT2     EQU  *
1066:A5 02      91          LDA  B2         ; B2 (LO BYTE) = $00?
1068:D0 B4      92          BNE  LOOP2      ; NO, REPEAT LOOP2.
106A:           93 NXT1     EQU  *
106A:88         94          DEY             ; DECREMENT COL. POINTER.
106B:10 A9      95          BPL  LOOP1      ; REPEAT UNTIL COL. < 0.
106D:           96 *-----END OF JOB
106D:A9 80      97          LDA  #$80       ; SET EOJ INDICATOR.
106F:85 0C      98          STA  EOJSW      ; .
1071:18         99          CLC             ; (FORCE NEXT BRANCH)
1072:90 2A      100         BCC  NOTEQ      ; CAUSES FINAL TABLE ENTRY.
1074:           101 *-----PROCESS SCREEN BYTE
1074:           102 PRSB    EQU  *
1074:B1 06      103         LDA  (B4),Y     ; LOAD SCREEN BYTE.
1076:24 0B      104         BIT  FTSW       ; FIRST TIME?
1078:30 24      105         BMI  NOTEQ      ; YES, TREAT AS NOT EQ.
107A:C5 08      106         CMP  PREVX      ; SCREEN BYTE = PREV.?
107C:D0 20      107         BNE  NOTEQ      ; NO, GOTO NOT EQUAL ROUTINE.
107E:A6 0A      108         LDX  RPTCT      ; HAS RPTCT REACHED
                                              MAXIMUM ($FF)?
1080:E0 FF      109         CPX  #$FF       ; .
1082:F0 1A      110         BEQ  NOTEQ      ; YES, TREAT AS NOT EQ.
1084:E6 0A      111         INC  RPTCT      ; BUMP REPEAT COUNT.
1086:E8         112         INX             ; AND X-REG (CONTAINING A
                                              TEMP. COPY).
1087:E0 04      113         CPX  #4         ; REPEAT COUNT >= 4?
1089:B0 0E      114         BGE  SAVBYTE    ; YES, SKIP DOWN TO SAVBYTE.
108B:           115 PRSB1   EQU  *
108B:C5 09      116         CMP  RPTCD      ; SCREEN BYTE = RPTCD?
108D:F0 0A      117         BEQ  SAVBYTE    ; YES, SKIP DOWN TO SAVBYTE.
108F:A2 00      118         LDX  #0         ; (FOR NEXT INST. ONLY)
1091:81 00      119         STA  (TBPTR,X)  ; COPY SCREEN BYTE TO TABLE.
1093:E6 00      120         INC  TBPTR      ; INCREMENT TBPTR.
1095:D0 02      121         BNE  SAVBYTE    ; .
1097:E6 01      122         INC  TBPTR+1    ; .
1099:           123 SAVBYTE EQU  *
1099:85 08      124         STA  PREVX      ; SAVE SCREEN BYTE FOR
                                              CMP TO NEXT.
109B:18         125         CLC             ; (FORCE NEXT BRANCH)
109C:90 B6      126         BCC  NXT4       ; RETURN TO MAIN LINE.
109E:           127 NOTEQ   EQU  *
109E:AA         128         TAX             ; SAVE A-REG.
109F:48         129         PHA             ; .
10A0:98         130         TYA             ; SAVE Y-REG.
10A1:48         131         PHA             ; .
10A2:8A         132         TXA             ; (GET A BACK.)
10A3:A2 00      133         LDX  #0         ; CLEAR X-REG.
10A5:           134 * X-REG TO INDICATE IF RPTCD FOUND IN SCREEN
                                              (0=NO, 1=YES).
10A5:C5 09      135         CMP  RPTCD      ; SCREEN BYTE = RPTCD?
10A7:D0 05      136         BNE  N1         ; NO, SKIP TO N1.
10A9:A0 02      137         LDY  #2         ; SET POINTER OFFSET = 2.
10AB:91 00      138         STA  (TBPTR),Y  ; PUT SCRN BYTE IN TBL
                                              AT TBPTR+2.
10AD:E8         139         INX             ; INDICATE THAT RPTCD WAS FOUND.
10AE:           140 N1      EQU  *
10AE:A5 00      141         LDA  TBPTR      ; SUBTRACT 3 FROM TBPTR.
10B0:38         142         SEC             ; .
10B1:E9 03      143         SBC  #3         ; .
10B3:85 00      144         STA  TBPTR      ; .
10B5:B0 02      145         BCS  N2         ; .
10B7:C6 01      146         DEC  TBPTR+1    ; .
10B9:           147 N2      EQU  *
10B9:24 0B      148         BIT  FTSW       ; FIRST TIME, GOTO N4.
10BB:30 17      149         BMI  N4         ; .
10BD:A5 0A      150         LDA  RPTCT      ; RPTCT >= 4?
10BF:C9 04      151         CMP  #4         ; .
10C1:B0 06      152         BGE  N3         ; YES, GOTO N3.
10C3:A5 08      153         LDA  PREVX      ; PREVX = RPTCD?
10C5:C5 09      154         CMP  RPTCD      ; .
10C7:D0 0B      155         BNE  N4         ; NO, SKIP TO N4.
10C9:           156 N3      EQU  *
10C9:A0 00      157         LDY  #0         ; ZERO POINTER OFFSET.
10CB:A5 09      158         LDA  RPTCD      ; STORE RPTCD IN TABLE.
10CD:91 00      159         STA  (TBPTR),Y  ; .
10CF:C8         160         INY             ; BUMP OFFSET.
10D0:A5 0A      161         LDA  RPTCT      ; STORE RPTCT IN TABLE.
10D2:91 00      162         STA  (TBPTR),Y  ; .
10D4:           163 N4      EQU  *
10D4:86 0B      164         STX  FTSW       ; TURN OFF FTSW (X=0 OR 1 HERE).
10D6:A5 00      165         LDA  TBPTR      ; GET TBPTR.
10D8:E0 01      166         CPX  #1         ; RPTCD FOUND IN TABLE?
10DA:18         167         CLC             ; (...'ADC' COMING)
10DB:D0 05      168         BNE  N4A        ; NO, SKIP DOWN...
```

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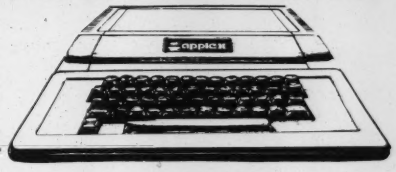

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CIRCLE 141 ON READER SERVICE CARD

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yes, they are trying to take over the world
JOHN, IS IT IMPORTANT THAT COMPUTERS ARE TRYING TO TAKE OVER THE WORLD?
yes
WHY IS IT IMPORTANT?
because i dont want to work for a computer
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CIRCLE 174 ON READER SERVICE CARD

Packer, continued...

```
10DD:69 06      169         ADC  #6         ; YES, ADD 6.
10DF:B8         170         CLV              ; (FORCE NEXT BRANCH)
10E0:50 02      171         BVC  N4B         ; CONTINUE.
10E2:           172 N4A     EQU  *
10E2:69 03      173         ADC  #3          ; ADD 3, INSTEAD.
10E4:           174 N4B     EQU  *
10E4:85 00      175         STA  TBPTR       ; BUMPS TBPTR TO NEXT AVAIL LOC.
10E6:90 02      176         BCC  N5          ; .
10E8:E6 01      177         INC  TBPTR+1     ; .
10EA:           178 N5      EQU  *
10EA:A9 01      179         LDA  #1          ; RESET RPTCT TO 1.
10EC:85 0A      180         STA  RPTCT       ; .
10EE:68         181         PLA              ; RESTORE Y.
10EF:A8         182         TAY              ; .
10F0:68         183         PLA              ; RESTORE A.
10F1:24 0C      184         BIT  EOJSW       ; END OF JOB?
10F3:10 96      185         BPL  PRSB1       ; NO, FINISH PROCESSING
                                               SCREEN BYTE.
10F5:60         186         RTS              ; YES, RETURN TO CALLER.

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

```
----- NEXT OBJECT FILE NAME IS HR.UNPACKER.OBJ0
0300:             2          ORG  $300
                  3 ************************************************
0300:             4 *-PROGRAM: HR.UNPACKER
0300:             5 *-VERSION: 1.0
0300:             6 *-WRITTEN BY: KEN HALEY
0300:             7 *-DATE: 7/15/81
0300:             8 *-HI-RES SCREEN EXPANSION ROUTINE
0300:             9 *- RESTORES HI-RES SCREEN FROM COMPRESSED
0300:            10 *- DATA BUILT BY HR.PACKER.
                 11 ************************************************
0000:            12          DSECT            ; PAGE ZERO VARIABLES.
0000:            13          ORG  0           ; .
0000:00 00       14 TBPTR    DW   0           ; POINTER TO END OF PACKED
                                                 PICTURE.
0002:00 00       15 B2       DW   0           ; LOOP2 COUNTER
0004:00 00       16 B3       DW   0           ; LOOP3 COUNTER
0006:00 00       17 B4       DW   0           ; LOOP4 COUNTER
0008:00          18 RPTCD    DFB  0           ; REPEAT CODE (WILL = '$FE')
0009:00          19 RPTCT    DFB  0           ; COUNT OF REPEATING BYTES
000A:00          20 RPTSW    DFB  0           ; REPEATING IN PROGRESS?
                                                 (MSB ON = YES)
000B:00          21 CURCH    DFB  0           ; CURRENT CHARACTER (FROM TABLE)
0300:            22          DEND             ; (END OF PAGE ZERO DEFINITIONS)
0300:            23 *-----INITIALIZATION
0300:A9 00       24          LDA  #$00        ; SET TBPTR = $4000.
0302:85 00       25          STA  TBPTR       ; .
0304:A9 40       26          LDA  #$40        ; .
0306:85 01       27          STA  TBPTR+1     ; .
0308:A9 FE       28          LDA  #$FE        ; SET RPTCD = $FE.
030A:85 08       29          STA  RPTCD       ; .
030C:A9 00       30          LDA  #0          ; SET RPTSW OFF.
030E:85 0A       31          STA  RPTSW       ; .
0310:            32 *
0310:            33 *-----MAIN LINE
0310:A0 27       34          LDY  #39         ; SET Y = 39.
0312:            35 * (Y-REG NOW CONTAINS COLUMN NO.)
0312:            36 LOOP1    EQU  *
0312:A9 78       37          LDA  #$78        ; SET B2 = $2078.
0314:85 02       38          STA  B2          ; .
0316:A9 20       39          LDA  #$20        ; .
0318:85 03       40          STA  B2+1        ; .
031A:            41 LOOP2    EQU  *
031A:A5 02       42          LDA  B2          ; SUBTRACT $28 FROM B2.
031C:38          43          SEC              ; .
031D:E9 28       44          SBC  #$28        ; .
031F:85 02       45          STA  B2          ; .
0321:B0 02       46          BCS  L2A         ; .
0323:C6 03       47          DEC  B2+1        ; .
0325:            48 L2A      EQU  *
0325:A5 02       49          LDA  B2          ; SET B3 = B2 + $400
0327:85 04       50          STA  B3          ; .
0329:A5 03       51          LDA  B2+1        ; .
032B:18          52          CLC              ; .
032C:69 04       53          ADC  #$4         ; .
032E:85 05       54          STA  B3+1        ; .
0330:            55 LOOP3    EQU  *
0330:A5 04       56          LDA  B3          ; SUBTRACT $80 FROM B3.
0332:38          57          SEC              ; .
0333:E9 80       58          SBC  #$80        ; .
```

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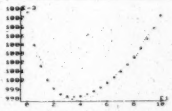

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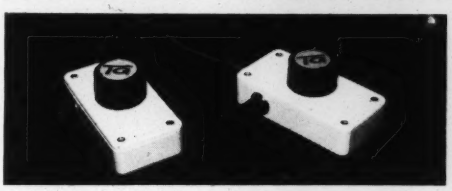

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CIRCLE 239 ON READER SERVICE CARD

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CIRCLE 195 ON READER SERVICE CARD

```
0335:85 04      59          STA  B3          ; .
0337:B0 02      60          BCS  L3A         ; .
0339:C6 05      61          DEC  B3+1        ; .
033B:           62 L3A      EQU  *
033B:A5 04      63          LDA  B3          ; SET B4 = B3 + $2000.
033D:85 06      64          STA  B4          ; .
033F:A5 05      65          LDA  B3+1        ; .
0341:18         66          CLC              ; .
0342:69 20      67          ADC  #$20        ; .
0344:85 07      68          STA  B4+1        ; .
0346:           69 LOOP4    EQU  *
0346:A5 07      70          LDA  B4+1        ; SUBTRACT $400 FROM B4.
0348:38         71          SEC              ; .
0349:E9 04      72          SBC  #$4         ; .
034B:85 07      73          STA  B4+1        ; .
034D:18         74          CLC              ; (FORCE NEXT BRANCH)
034E:90 1A      75          BCC  PRSB        ; PROCESS SCREEN BYTE.
0350:           76 NXT4     EQU  *
0350:A5 07      77          LDA  B4+1        ; B4 = B3?
0352:C5 05      78          CMP  B3+1        ; .
0354:D0 F0      79          BNE  LOOP4       ; NO, REPEAT LOOP4.
0356:           80 NXT3     EQU  *
0356:A5 04      81          LDA  B3          ; B3 = B2?
0358:C5 02      82          CMP  B2          ; .
035A:D0 D4      83          BNE  LOOP3       ; NO, REPEAT LOOP3.
035C:A5 05      84          LDA  B3+1        ; .
035E:C5 03      85          CMP  B2+1        ; .
0360:D0 CE      86          BNE  LOOP3       ; .
0362:           87 NXT2     EQU  *
0362:A5 02      88          LDA  B2          ; B2 (LO BYTE) = $00?
0364:D0 B4      89          BNE  LOOP2       ; NO, REPEAT LOOP2.
0366:           90 NXT1     EQU  *
0366:88         91          DEY              ; DECREMENT COL. POINTER.
0367:10 A9      92          BPL  LOOP1       ; REPEAT UNTIL COL. < 0.
0369:           93 *-----END OF JOB
0369:60         94          RTS              ; RETURN TO CALLER.
036A:           95 *-----PROCESS SCREEN BYTE
036A:           96 PRSB     EQU  *
036A:24 0A      97          BIT  RPTSW       ; REPEAT IN PROGRESS?
036C:30 38      98          BMI  PRSB2       ; YES, GOTO PRSB2.
036E:A2 00      99          LDX  #0          ; (FOR NEXT INST.)
0370:A1 00     100          LDA  (TBPTR,X)   ; GET TABLE BYTE.
0372:85 0B     101          STA  CURCH       ; SAVE IT.
0374:C5 08     102          CMP  RPTCD       ; = REPEAT CODE?
0376:D0 21     103          BNE  PRSB1       ; NO, SKIP DOWN...
0378:E6 00     104          INC  TBPTR       ; YES, BUMP TABLE POINTER.
037A:D0 02     105          BNE  N1          ; .
037C:E6 01     106          INC  TBPTR+1     ; .
037E:          107 N1       EQU  *
037E:A1 00     108          LDA  (TBPTR,X)   ; GET RPTCT FROM TABLE.
0380:85 09     109          STA  RPTCT       ; .
0382:E6 00     110          INC  TBPTR       ; BUMP TABLE POINTER.
0384:D0 02     111          BNE  N2          ; .
0386:E6 01     112          INC  TBPTR+1     ; .
0388:          113 N2       EQU  *
0388:A1 00     114          LDA  (TBPTR,X)   ; GET CURCH FROM TABLE.
038A:85 0B     115          STA  CURCH       ; .
038C:E6 00     116          INC  TBPTR       ; BUMP TABLE POINTER.
038E:D0 02     117          BNE  N3          ; .
0390:E6 01     118          INC  TBPTR+1     ; .
0392:          119 N3       EQU  *
0392:A9 80     120          LDA  #$80        ; SET RPTSW.
0394:85 0A     121          STA  RPTSW       ; .
0396:18        122          CLC              ; (FORCE NEXT BRANCH)
0397:90 0D     123          BCC  PRSB2       ; GOTO PRSB2.
0399:          124 PRSB1    EQU  *
0399:A5 0B     125          LDA  CURCH       ; PUT CURCH ONTO SCREEN.
039B:91 06     126          STA  (B4),Y      ; .
039D:E6 00     127          INC  TBPTR       ; BUMP TABLE POINTER.
039F:D0 02     128          BNE  N4          ; .
03A1:E6 01     129          INC  TBPTR+1     ; .
03A3:          130 N4       EQU  *
03A3:18        131          CLC              ; (FORCE NEXT BRANCH)
03A4:90 AA     132          BCC  NXT4        ; RETURN TO MAIN LINE.
03A6:          133 PRSB2    EQU  *
03A6:A5 0B     134          LDA  CURCH       ; PUT CURCH ONTO SCREEN.
03A8:91 06     135          STA  (B4),Y      ; .
03AA:C6 09     136          DEC  RPTCT       ; DECREMENT REPEAT COUNTER.
03AC:D0 A2     137          BNE  NXT4        ; RETURN TO MAINLINE IF STILL +.
03AE:A9 00     138          LDA  #0          ; OTHERWISE TURN OFF RPTSW.
03B0:85 0A     139          STA  RPTSW       ; .
03B2:F0 9C     140          BEQ  NXT4        ; ...AND RETURN.

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```


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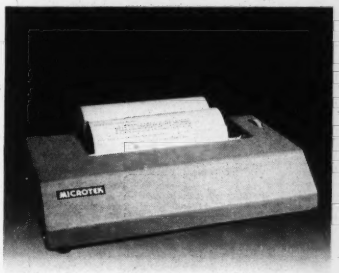

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*Data Source: Epson MX-800 Operation Manual

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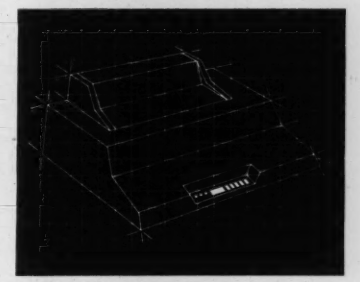

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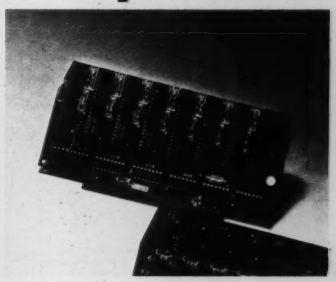

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CARD GAMES

BRIDGE 2.0 (Available for all computers) — **Price: $17.95 Cassette/$21.95 Diskette**
An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice. See the software review in 80 Software Critique. Rated #1 by Creative Computing.

HEARTS 1.5 (Available for all computers) — **Price: $15.95 Cassette/$19.95 Diskette**
An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies. HEARTS 1.5 is an ideal game for introducing the uninitiated (your spouse) to computers. See the software review in 80 Software Critique.

STUD POKER (Atari only) — **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic gambler's card game. The computer deals the cards one at a time and you (and the computer) bet on what you see. The computer does not cheat and *usually* bets the odds. However, it sometimes bluffs! Also included is a five card draw poker betting practice program. This package will run on a 16K ATARI. Color, graphics, sound. See review in COMPUTE.

POKER PARTY (Available for all computers) — **Price: $17.95 Cassette/$21.95 Diskette**
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple cassette and diskette versions require a 32 K (or larger) Apple II.

CRIBBAGE 2.0 (TRS-80 only) — **Price: $14.95 Cassette/$18.95 Diskette**
This is simply the best cribbage game available. It is an excellent program for the cribbage player in search of a worthy opponent as well as for the novice wishing to improve his game. The graphics are superb and assembly language routines provide rapid execution. See the software review in 80 Software Critique.

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Atari, North Star and CP/M only) — **Price: $19.95 Cassette $23.95 Diskette**
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) — **Price: $17.95 Cassette/$21.95 Diskette**
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS. Runs in 16K Atari.

VALDEZ (Available for all computers) — **Price: $15.95 Cassette/$19.95 Diskette**
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other-traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software review in 80 Software Critique.

BACKGAMMON 2.0 (Atari, North Star and CP/M only) — **Price: $14.95 Cassette/$18.95 Diskette**
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play against itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHECKERS 3.0 (PET only) — **Price: $16.95 Cassette/$20.95 Diskette**
This is one of the most challenging checkers programs available. It has 10 levels of play and allows the user to change skill levels at any time. Although providing a very tough game at level 4-8, CHECKERS 3.0 is practically unbeatable at levels 9 and 10.

CHESS MASTER (North Star and TRS-80 only) — **Price: $19.95 Cassette/$23.95 Diskette**
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users. See review in onComputing.

LEM LANDER (32K Apple Disk only) — **Price: $16.95 Diskette**
Pilot your LEM LANDER to a safe landing on any of nine different surfaces ranging from smooth to treacherous. The game paddles are used to control craft attitude and thrust. This is a real-time high res challenge!

FOREST FIRE! (Atari only) — **Price: $16.95 Cassette/$20.95 Diskette**
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalties. Life-like variables are provided to make FOREST FIRE! very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.

NOMINOES JIGSAW (Atari, Apple and TRS-80 only) — **Price: $16.95 Cassette/$20.95 Diskette**
A jigsaw puzzle on your computer! Complete the puzzle by selecting your pieces from a table consisting of 60 different shapes. NOMINOES JIGSAW is a virtuoso programming effort. The graphics are superlative and the puzzle will challenge you with its three levels of difficulty. Scoring is based upon the number of guesses taken and by the difficulty of the board set-up. See review in ELECTRONIC GAMES.

MONARCH (Atari only) — **Price: $11.95 Cassette/$15.95 Diskette**
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy.

CHOMPELO (Atari only) — **Price: $11.95 Cassette/$15.95 Diskette**
CHOMPELO is really two challenging games in one. One is similar to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. The other game is the popular board game REVERSI. It fully uses the Atari's graphics capability, and is hard to beat. This package will run on a 16K system.

SPACE LANES (Available for all computers) — **Price: $14.95 Diskette**
SPACE LANES is a simple but exciting space transportation game which involves up to four players (including the computer). The object is to form and expand space transportation companies in a competitive environment. The goal is to amass more net worth than your opponent. The economics include stock purchases and company mergers. Watch your wealth grow!

**ATARI, PET, TRS-80, NORTHSTAR, CP/M and IBM are registered tradenames and/or trademarks.*

***Except where noted, all model I software is available for the Model III. TRS-80 diskettes are not supplied with DOS or BASIC.*

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This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

BLACK HOLE (Apple only) — **Price: $14.95 Cassette/$18.95 Diskette**
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

SPACE TILT (Apple and Atari only) — **Price: $10.95 Cassette/$14.95 Diskette**
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

MOVING MAZE (Apple and Atari only) — **Price: $10.95 Cassette/$14.95 Diskette**
MOVING MAZE employs the games paddles to direct a puck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

ALPHA FIGHTER (Atari only) — **Price: $14.95 Cassette/$18.95 Diskette**
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

THE RINGS OF THE EMPIRE (Atari only) — **Price: $16.95 Cassette/$20.95 Diskette**
The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

INTRUDER ALERT (Atari only) — **Price: $16.95 Cassette/$20.95 Diskette**
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

GIANT SLALOM (Atari only) — **Price: $14.95 Cassette/$18.95 Diskette**
This real-time action game is guaranteed addictive! Use the joystick to control your path through slalom courses consisting of both open and closed gates. Choose from different levels of difficulty, race against other players or simply take practice runs against the clock. GIANT SLALOM will run on 16K systems.

TRIPLE BLOCKADE (Atari only) — **Price: $14.95 Cassette/$18.95 Diskette**
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) — **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) — **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

MOON PROBE (Atari and North Star only) — **Price: $11.95 Cassette/$15.95 Diskette**
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle.

SPACE TRAP (Atari only, 16K) — **Price: $14.95 Cassette/$18.95 Diskette**
This galactic "shoot'em up" arcade game places you near a black hole. You control your spacecraft using the joystick and attempt to blast as many of the alien ships as possible before the black hole closes about you.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) — **Price: $21.95 Diskette**
At last! A comprehenive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette. Not available in 5¼" CP/M format.

GUMBALL RALLY ADVENTURE (North Star only, 48K) — **Price: $21.95 Diskette**
Take part in this outlaw race from the east coast to the west coast. The goal is to find your way to the finish line while maintaining the highest possible speed. You may choose one of five cars available at the garage. The choice will affect your speed and range. Remember to take spare parts and don't get caught speeding!

SPEECH SYNTHESIS

DYNACOMP is now distributing the new and revolutionary TYPE-'N-TALK™ (TNT) speech synthesizer from Votrax. Simply connect TNT to your computer's serial interface, enter text from the keyboard and hear the words spoken. TNT is the easiest-to-program speech synthesizer on the market. It uses the least amount of memory and provides the most flexible vocabulary available anywhere!

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TNT Software

The following DYNACOMP programs are available for use with TNT:

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NOMINOES JIGSAW (Atari, 24K)
TEACHER'S PET 1 (Atari and North Star)
BRIDGE 2.0 (North Star)
CHOMPELO (Atari, 24K)

TALK TO ME (T'N'T Atari only, 24K) — **Price: $14.95 Cassette/$18.95 Diskette**
This program presents a superb tutorial on speech synthesis using the Atari 800 and TYPE 'N TALK™. TALK TO ME will illustrate normal word generation as well as phoneme generation. The documentation includes many helpful programming tips.

Please specify 'TNT' versions when ordering.

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DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 40 countries). During the past two years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique and A.N.A.L.O.G. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

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This program is unmatched in its ability to store a maximum number of addresses on one diskette (minimum of 1100 per diskette, more than 2200 for "double density" systems!). Its many features include alphabetic and zip code sorting, label printing (1, 2, or 3 up), merging of files and a unique keyword seeking routine which retrieves entries by a virtually limitless selection of user defined codes. Mail List 2.2 will even find and delete duplicate entries. A very valuable program!

FORM LETTER SYSTEM rel. 2 (Atari, North Star and Apple Diskettes only) — **Price: $34.95**

FORM LETTER SYSTEM (FLS) is the ideal program for creating and editing form letters and address lists. It contains an easy-to-use text editor which produces fully justified text. Special codes are used in the address list to obtain personalized salutations. Form letters are produced by automatically inserting each address into a predetermined portion of your letter. FLS is completely compatible with MAIL LIST 2.2, which may be used to manage and sort your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $59.95.

SORTIT (North Star only) — **Price: $29.95 Diskette**

SORTIT is a general purpose sorting program written in 8080 assembly language. This program will sort sequential data files generated by NORTH STAR BASIC. Primary and optional secondary keys may be numeric or one to nine character strings. SORTIT is easily used with files generated by DYNACOMP's MAIL LIST program and is very versatile in its capabilities for all other BASIC data file sorting.

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PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations.

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FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

INTELINK (Atari only) — **Price: $49.95 Diskette**

This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "up-loaded" to another computer, making the Atari a *very* smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

TEXT EDITOR II (CP/M) — **Price: $29.95 Diskette/$33.45 Disk**

This is the second release version of DYNACOMP's popular TEXT EDITOR I and contains many new features. With TEXT EDITOR II you may build text files in chunks and assemble them for later display. Blocks of text may be appended, inserted or deleted. Files may be saved on disk/diskette in right justified/centered format to be later printed by either TEXT EDITOR II or the CP/M ED facility. Futher, ASCII CP/M files (including BASIC and assembly language programs) may be read by the editor and processed. In fact, text files can be built using ED and later formatted using TEXT EDITOR II. All in all, TEXT EDITOR II is an inexpensive, easy to use, but very flexible editing system.

DFILE (Atari and North Star diskettes only) — **Price: $19.95**

This handy program allows North Star and Atari disk users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

FINDIT (North Star only) — **Price: $19.95**

This is a three-in-one program which maintains information accessible by keywords of three types: Personal (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

SHOPPING LIST (Atari only) — **Price: $12.95 Cassette/$16.95 Diskette**

SHOPPING LIST stores information on items you purchase at the supermarket. Before going shopping, it will remind you of all the things you might need, and then display (or optionally print) your shopping list and the total cost. Adding, deleting, changing and storing data is very easy. Runs with 16K.

TAX OPTIMIZER (North Star only) — **Price: $59.95 Diskette**

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NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY

DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

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AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running under MBASIC. 5¼" CP/M diskettes are available for North Star and Osborne computer systems.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — **Price: $39.95 Cassette/$43.95 Diskette**

DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. The filter forms are subsequently converted into non-recursive convolution coefficients which permit rapid data processing. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — **Price: $19.95 Cassette/$23.95 Diskette**

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — **Price: $19.95 Cassette/$23.95 Diskette**

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — **Price: $34.95 Cassette/$38.95 Diskette**

HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

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In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2 (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular texts *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* by F. Ruckdeschel (see advertisements in BYTE magazine). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

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Collection #5: Chapter 5 - Table interpolation, differentiation and integration (Newton, LaGrange, splines).
Collection #6: Chapter 6 - Methods for finding the real roots of functions.
Collection #7: Chapter 7 - Methods for finding the complex roots of functions.
Collection #8: Chapter 8 - Optimization by steepest descent.
Price per collection: $14.95 Cassette/$18.95 Diskette
All eight collections are available for $99.95 (eight cassettes) and $129.95 (eight diskettes).
Because the texts are a vital part of the documentation, *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* are available from DYNACOMP:

BASIC SCIENTIFIC SUBROUTINES, Vol 1 (319 pages): $19.95 + 75¢ postage
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PAGE FLIPPING

David Lubar

The switches that flip between various text and graphic modes on the Apple allow for some interesting effects. At the high end, smooth animation is possible by drawing on the unseen screen, then flipping it into view. While such feats are beyond the scope of this article, a few simple techniques that show some of the potential of screen flipping will be discussed. The key numbers to keep in mind are those from 49232 to 49239. Poking any of these locations will set a specific switch. Depending on the other switches, various combinations of text and graphics will be produced. See Table 1 for a chart of the switches. Now let's put some of this information to work. Suppose you have a hi-res display, and you want a quick flash of something else. Being trite, assume the phrase 'YOU LOSE" is displayed in large block letters on the lo-res screen. The message could be flashed with the following code

```
100 POKE 49238,0 :REM TURN ON LO-
    RES
110 FOR D=1 TO 100 : NEXT D :REM
    DELAY A BIT
120 POKE 49239,0 : REM BACK TO HI-
    RES
```

Now, how does the image get on the lo-res screen? In most cases it can be drawn by the program. Even if the hi-res display is on, lo-res commands will be carried out. The computer doesn't care what is being displayed. But what if you need several different images to flash at different times, or what if there is no time for the program to create the display? The answer is a short (very short) machine language program (Listing 1) that takes a screen image from elsewhere in RAM and puts it in the lo-res memory. The nice feature of the program is that it leaves any text in the window undisturbed.

The program can be accessed from Basic. The user pokes the address of the image he has saved into locations 0 and 1. For instance, if the image is stored at $6000, the user would POKE 0,0 and POKE 1,96. The way to avoid disturbing the text window is to use some sort of signal or flag byte. In this example $AB is used since it probably won't occur in lo-res data. Whenever the routine encounters $AB, that byte isn't moved. To avoid the drudgery of putting $AB into many locations, the Basic program in Listing 2 sets up the screen image. The entire process is as follows. First, the desired lo-res image is created using graphics commands such as PLOT and VLIN. Next, the image must be moved into location $1000. This is done by entering the monitor with CALL -151 and typing 1000 < 400.7FFM. Next, get

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Page Flipping, continued...

```
:ASM
                    1    *ROUTINE TO MOVE A SCREEN
                    2    *IMAGE INTO LO-RES MEMORY
                    3    *USER MUST PUT POINTERS
                    4    *TO IMAGE INTO LOCATIONS
                    5    *$00 AND $01
                    6    *
                    7    *PROGRAM IS RELOCATABLE
                    8    *
                    9              ORG  $300
                   10    SRCLO     EQU  $0
                   11    SRCHI     EQU  $01
                   12    DESTLO    EQU  $02
                   13    DESTHI    EQU  $03
                   14    *
0300: A9 04        15    START     LDA  #$04    ;HI BYTE OF SCREEN START
0302: 85 03        16              STA  DESTHI ;SET UP ZERO PAGE POINTERS
0304: AA           17              TAX         ;CONVENIENT COUNTER
0305: A9 00        18              LDA  #$0
0307: 85 02        19              STA  DESTLO
                   20    *DESTLO NOW POINTS TO $400
0309: A8           21              TAY         ;ZERO OUT Y
030A: B1 00        22    LOOP      LDA  (SRCLO),Y ;GET A BYTE FROM THE SOURCE
030C: C9 AB        23              CMP  #$AB    ;SHOULD IT BE TRANSFERRED?
030E: F0 02        24              BEQ  NEXT    ;NO
0310: 91 02        25              STA  (DESTLO),Y ;YES, PUTY IT ON THE SCREEN
0312: C8           26    NEXT      INY         ;POINT TO NEXT BYTE
0313: D0 F5        27              BNE  LOOP    ;TRANSFER A FULL PAGE
0315: E6 01        28              INC  SRCHI   ;INCREASE HI BYTES OF POINTERS
0317: E6 03        29              INC  DESTHI ;FOR NEXT PAGE
0319: CA           30              DEX         ;FOUR PAGES DONE?
031A: D0 EE        31              BNE  LOOP    ;NO
031C: 60           32              RTS         ;YES


--- END ASSEMBLY ---

TOTAL ERRORS: 0

29 BYTES GENERATED THIS ASSEMBLY
```

Listing 1.

```
1  REM  THIS PROGRAM FLAGS THE FOUR TEXT LINES IN A SCREEN IMAGE
2  REM  THE IMAGE MUST BE AT $1000
10  FOR I = 4688 TO 4688 + 47
20  FOR J = 0 TO 3
30  POKE I + J * 128,171
40  NEXT J,I
```

Listing 2.

back to Basic with 3D0G (for DOS users) or Control-C (for cassette users) and run the program in Listing 2. The image is now ready and can be saved to disk with BSAVE NAME, A$1000,L$3F8 (the last eight bytes are unneeded and will just waste an extra disk sector). For cassette, the 400.7F8W from the monitor. Later, the image can be brought into any free area of memory and put on the screen using the program in Listing 1.

Unlike the Atari, the Apple is not blessed with internal knowledge of the video signal. This means that rapid page flipping can lead to undesirable results. It works like this. The television is slaving away at what seems like high speed to us mortals. It fills the screen with lines, jumps back to the top, then does it again. To the 6502 chip in the Apple, this process takes forever. The 6502 can perform thousands of operations while the TV electron gun

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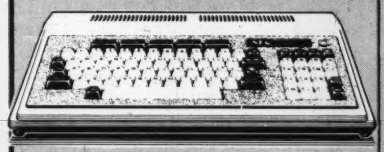

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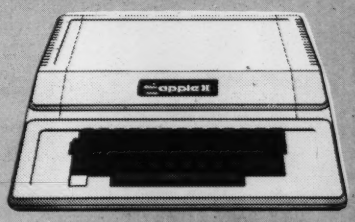

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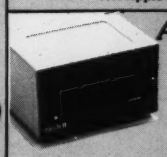

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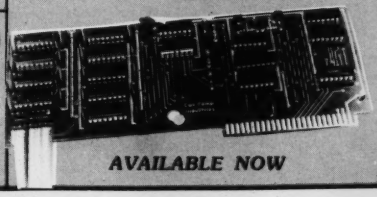

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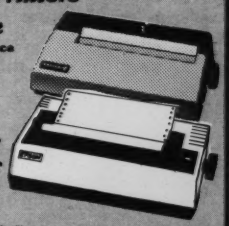

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1  REM  HIT ANY KEY TO STOP
2  REM  ERIC WOLCOTT HAD A HAND IN THIS
10  HGR : HCOLOR= 3: HPLOT 0,0 TO 279,191: HPLOT 279,0 TO 0,191:
 HGR2 : HPLOT 140,0 TO 140,191
50  FOR I = 768 TO 795: READ A: POKE I,A: NEXT I: CALL 768
100  DATA  173,80,192,173,87,192,173,84,192,169,11,32,168,252,17
3,85,192,169,11,32,168,252,173,0,192,16,235,96
```

Listing 3.

```
:ASM
                1     *A FAIRLY USELESS EXAMPLE
                2     *OF THE CONFLICT BETWEEN
                3     *SCREEN FLIPPING AND
                4     *RASTER SCANS
                5     *
                6     *RELOCATABLE CODE
                7     *
                8          ORG  $300
0300: AD 50 C0 9           LDA  $C050  ;TURN ON GRAPHICS MODE
0303: AD 57 C0 10          LDA  $C057  ;TURN ON HI-RES
0306: AD 54 C0 11   LOOP   LDA  $C054  ;TURN ON PAGE ONE
0309: A9 0B    12          LDA  #$0B    ;THIS VALUE SEEMS TO WORK WELL
030B: 20 A8 FC 13          JSR  $FCA8  ;MONITOR DELAY ROUTINE
030E: AD 55 C0 14          LDA  $C055  ;TURN ON PAGE TWO
0311: A9 0B    15          LDA  #$0B    ;USE SAME DELAY
0313: 20 A8 FC 16          JSR  $FCA8
0316: AD 00 C0 17          LDA  $C000  ;CHECK FOR KEYPRESS
0319: 10 EB    18          BPL  LOOP   ;NO PRESS
031B: 60       19          RTS         ;SOMEBODY WANTS OUT
--- END ASSEMBLY ---
TOTAL ERRORS: 0
28 BYTES GENERATED THIS ASSEMBLY
```

Listing 4.

Page Flipping, continued...

is making one pass on the screen. If the computer flips pages in less time than it takes the TV to refresh the screen, alternate chunks from the two pages will be displayed. Suppose the switch takes place with a delay equal to the time the TV requires to create ten lines. The top ten lines will be from the first page. The next ten will be from the second page, and so on. Slight differences in total timing will cause the whole pattern to drift. This can be seen in the Basic program from Listing 3. The program puts lines on the two hi-res pages, then calls a machine language routine. The routine, which is poked from Basic, is shown with comments in Listing 4. To experiment with this, try changing the values used in the two delays.

This problem can produce results that range from a slight flicker to temporary disappearance of a figure on the screen. Fortunately, applications of page flipping that use Basic usually operate at a slow enough relative speed to avoid this problem.

Page flipping can be a very valuable tool on the Apple, and on other computers with similar capabilities. The potential applications are quite diverse, and there are probably many new applications that can be found for this technique. □

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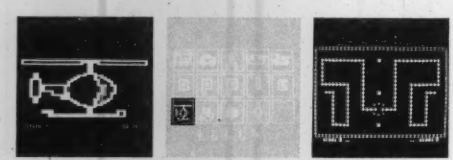

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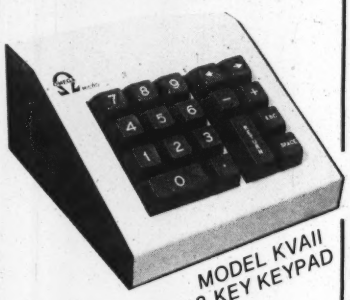

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Three-Dimensional Apple Graphics

Mark Pelczarski

Welcome to the world of 3-D graphics! The words you read on this page are certainly on a two-dimensional surface, but step back a minute and survey your surroundings. The world around you has another dimension: depth. Imagine looking at a computer screen; it is definitely two-dimensional. But on the same screen you can view television shows and movies that give the illusion of that third dimension. As people on the screen move further away, they appear to get smaller, as they move closer, they appear larger. Think about it.

The program accompanying this article works on an Apple II with 48K, disk drive, and Applesoft firmware (or the language system). It allows you to create line drawings that you can rotate, scale, and move around the screen in what will appear to be three dimensions. The program is in Basic, so don't expect to be able to do rapid 3-D animations with it. It is accurate, however, and fairly easy to use.

The program was sold for a short time, and to be fair, anyone who bought a copy is welcome to contact Co-op Software about trading it in for "The Complete Graphics System," which has, among other things, a much-improved machine language version of the 3-D program. The address for Co-op Software is P.O. Box 432, West Chicago, IL 60185, and the phone number is (312) 231-0912.

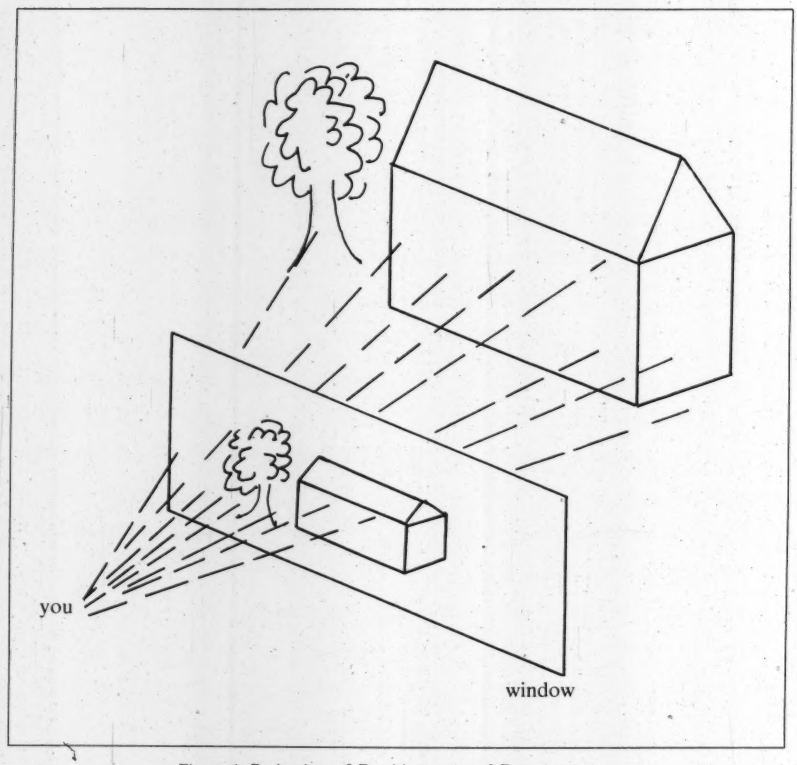


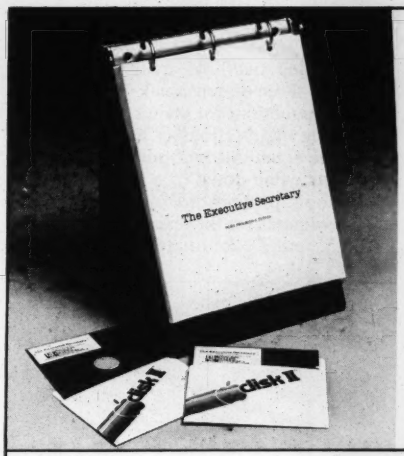
Figure 1. Projecting a 3-D subject onto a 2-D surface.

Projecting 3-D Images

To start, let's look at a technique for making an object appear three-dimensional on a two-dimensional screen, trying not to worry too much about mathematics, yet. Imagine your television screen as a window, with real 3-D objects behind it. Better yet, find a window and a grease pencil. Sit close enough so you can reach the window, and trace what you see outside onto the surface of the window with the pencil (before you start, you'd better make sure you can erase what you draw). You should wind up with a two-dimensional (the window surface) rendition of the three-dimensional outside; and it should be pretty accurate, or, as they say in 3-D graphics-land, in "true perspective."

How does it work, and how can that idea be transferred to a computer? See the drawing in Figure 1. Light travels in a straight line from the actual object, through the window, to your eyes (technical fiends will please disallow any refraction through the window). Where the lines intersect the window, you have an outline of the objects outside, projected on a two-dimensional surface. It's the same thing that happens on film in cam-

Mark Pelczarski, 1206 Kings Circle, West Chicago, IL 60185.



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CIRCLE 211 ON READER SERVICE CARD

eras. The mathematical key is that there are points on one side of a plane, connected with lines to a point on the other side of the plane, and where those lines intersect the plane is the two-dimensional projection. The points on one side are the object, the point on the other side is your eyes, the plane is the window, and the lines are the light.

Defining Some Program Storage

Now to set some structure to what we need for a computer rendition of all this. We'll define our objects as stick figures. We'll store a set of points with three-dimensional coordinates: X, Y, and Z. To stay somewhat consistent with what you already know about screen graphics, X will measure across the screen, left to right, Y will measure from the bottom of the screen to the top, and Z will measure the depth, from the screen surface, with positive values toward the back (see Figure 2). The point (0,0,0) will be at the center of the screen, on the screen. (Those of you familiar with 3-D coordinates will notice that the axes are tilted 90 degrees back from their usual orientation, to enable us to reference here to Z as depth.)

The points whose coordinates will be stored in memory will simply be endpoints of lines. No need to store every point of the line, since projected lines will still connect their projected endpoints. In addition to the coordinates of the endpoints, then, we'll also store a list of lines. These will be identified by the numbers of their two endpoints—sort of a three-dimensional "connect-the dots." Figure 3 shows how the cube in Figure 2 would be stored.

In a 48K Apple, there is comfortable room for 500 points and 750 lines, so define the following for storage:

X(499)—the x-coordinate of each point, 0 to 499

Y(499)—the y-coordinate of each point

Z(499)—the z-coordinate of each point

L%(749,1)—endpoints of lines 0 to 749; L%(I,0) is the number of one endpoint, and L%(I,1) is the other. The "%" makes L% an integer variable, which takes 2 bytes per element rather than 5, which it would take as a floating point variable.

The actual coordinates of an endpoint would be found using something like X(L%(I,0)), Y(L%(I,0)), and Z(L%(I,0)), where I is the number of the line, and L%(I,0) holds the point number.

If that's not confusing enough, the actual program uses an array P(499,2) for the points, rather than X, Y, and Z. If N is a point number, P(N,0) is the x-coordinate, P(N,1) is the y-coordinate, and P(N,2) is the z-coordinate. This shortens parts of the program by allowing loops, but for the purposes of this article, we'll use X, Y, and Z.

Putting an Object on the Screen

All the necessary factors are there: points are stored, the screen is the xy-plane, and your eye is somewhere out on the negative end of the z-axis (D1 is that distance in the program). When I started this part of program development, I assumed there would be some pretty heavy mathematics involved. After days of poring over old math books, going over three-dimensional equations of lines, equations for planes, techniques for finding intersections of lines and planes, all the equations for finding the projected points came down to a relatively simple relation: proportions. You need X and Y coordinates on the screen, and you have X, Y, and Z coordinates for the point you

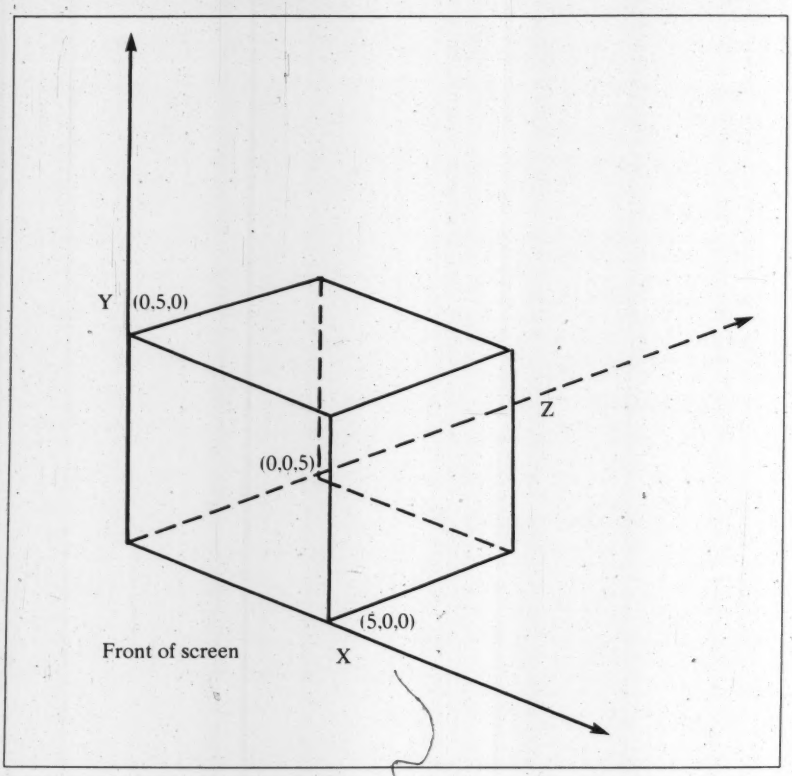

Figure 2. Axes.

Points				Lines		
#	X	Y	Z	#	From	To
0	0	0	0	0	0	1
1	5	0	0	1	1	2
2	5	5	0	2	2	3
3	0	5	0	3	3	0
4	0	0	5	4	4	5
5	5	0	5	5	5	6
6	5	5	5	6	6	7
7	0	5	5	7	7	4
				8	0	4
				9	1	5
				10	2	6
				11	3	7

Figure 3. Points and lines for a cube.

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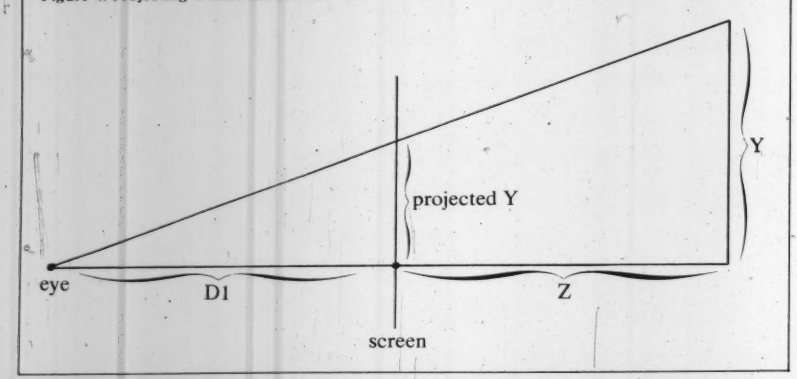
Figure 4. Projecting Y onto the screen.



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want projected. Imagining the lines shown in Figure 4 gives two similar triangles. You can compute the X and Y separately; the figure and following computation shows finding Y.

$$\frac{Y}{D1+Z} = \frac{\text{project } Y}{D1}$$

or

$$\text{project } Y = \frac{Y*D1,}{D1+Z,}$$

This computation is running around somewhere in lines 4385 and 4390 of the program. Unfortunately, by then I've already changed D1 to VZ, which does some scaling for the purposes of getting a decent size on the screen. 'TR' is the point, TRanslated onto the screen. Once this is done for the X and Y coordinates of each endpoint of a line, a line is drawn connecting the translated points. The process is repeated for each set of endpoints and each line.

More Fun—Moving an Object

Just looking at a 3-D object projected on the screen isn't actually a barrel of thrills unless you can do something to it, such as move it or turn it to see another angle. It's nicer to be able to see something on the screen like the little sports car that just came around the corner outside the window. First you see its side, then the front as it turns, then it gets larger (or appears to) as it approaches and drives past. (It's a good thing the car came by; I was about to try describing the building next door doing a 90 degree turn.)

There are two approaches to viewing other angles of an object: move the object, or move your viewpoint. Moving the object requires changing all the coordinates of the object. Moving the viewpoint would seem to require movement of only one point, but it makes translation to two dimensions a little more lengthy. With this program it's more beneficial to move the object, since later we'll also talk about having more than one object on the screen and moving each independently (such as moving one box so it's on top of another).

There are three basic operations we can do with an object: shifting, rotating, and scaling. Each operation somehow affects the coordinates of each point that is stored. None of the operations affects the line information, as lines simply connect their endpoints.

Shifting

Shifting is moving an object in a direction, and is the easiest. We can shift an object left or right by adding a negative or positive number, respectively, to every

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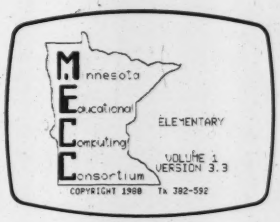

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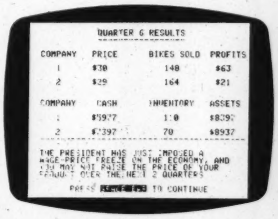
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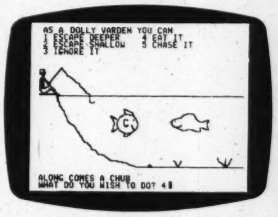
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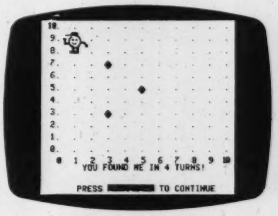

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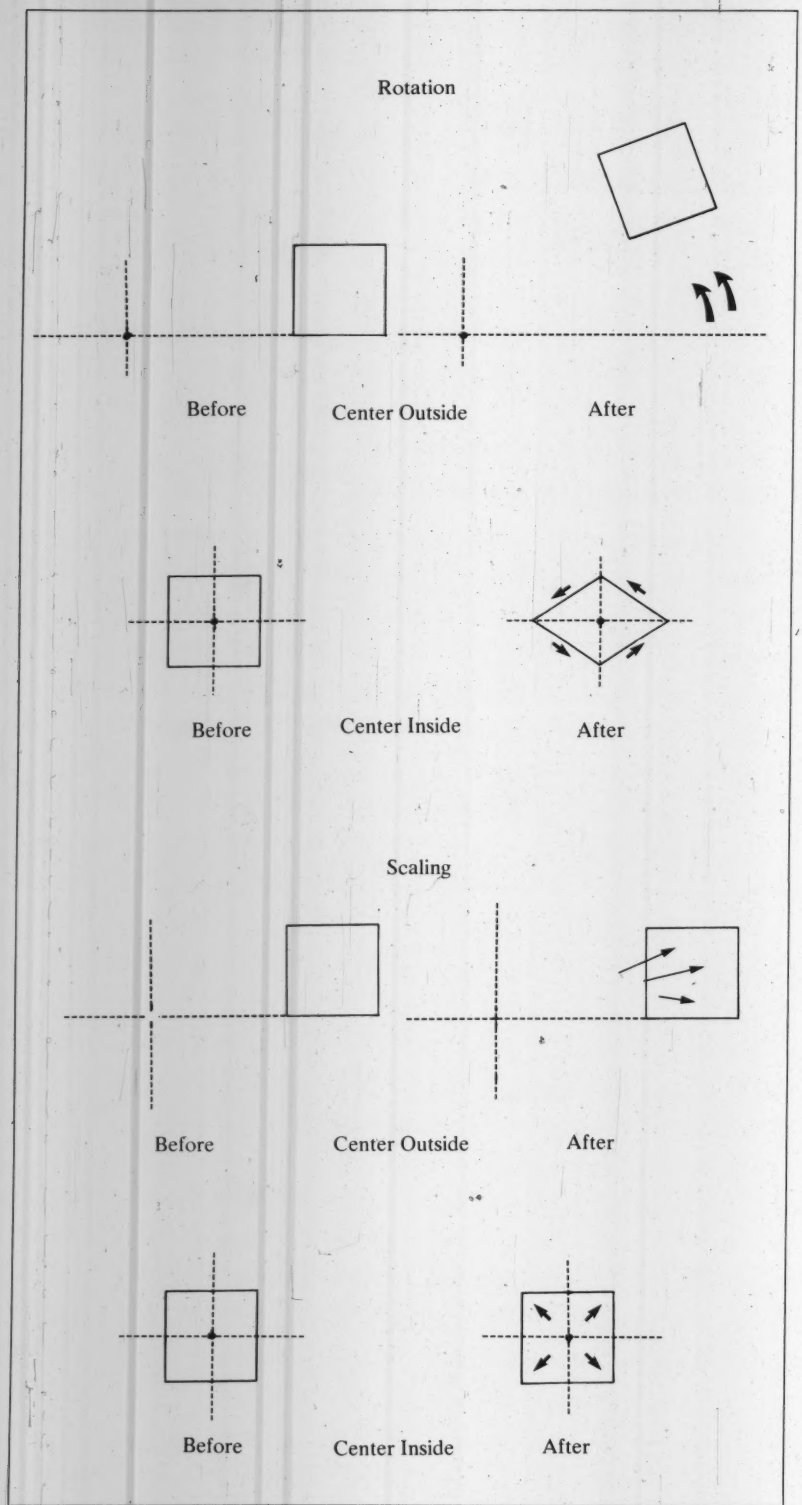

Figure 5. Scaling and Rotating with centers inside and outside object.

x-coordinate of the object. Shifting down or up is accomplished by adding to the y-coordinates, and shifting forward (towards you) or back (away) is accomplished by modifying the z-coordinates. The effect on the screen when shifting up, down, left, or right will be to move the object in that direction, but you will also get more (or less) view of the side of the object. It is comparable to looking at a building straight-on, then looking at it from slightly down the street. Down the street you'll not only see the front, you'll see some of the side. Shifting an object forward or back will make it appear larger or smaller, as real objects appear when you're closer or further from them.

Scaling

Rotation and scaling pose a new problem: both require some type of reference point. In scaling you need a point to scale out from. In rotating, you need a point to turn the object around. In both cases, it is usually most convenient to have this point in the center of the object. Figure 5 shows examples of both operations, each done with the reference point outside the object, then inside the object. In most cases, having this point outside the object will cause rotation or scaling to throw the object right off the screen (over in the closet, on my desk, or in the kitchen).

To solve this, a center point for the figure is computed before any operations are done. This is accomplished by averaging the largest and smallest x-value, the largest and smallest y-value, then the largest and smallest z-value. In the program, it's done in lines 3032-3038, and CR(0), CR(2) are the X, Y, and Z values of the computed center.

To scale a figure, the main step is to multiply every coordinate by a scaling factor, such as 2, to double the dimensions. This operation done to the cube in Figures 2 and 3 would change all the 5's to 10's, doubling the lengths of its sides. Without regarding a center, however, you can also send objects off into never-neverland, or off the screen, whichever comes first. The apparent center of a straight multiplication is the point 0,0,0. To incorporate your own center (the one that we computed) into the scaling involves a three-step process:

Step 1—Subtract the coordinates of the center from every point. This translates the figure to an identical figure that has 0,0,0 as the center.

Step 2—Multiply every coordinate by the scaling constant. This scales it out from the point 0,0,0, which is now within the figure.

Step 3—Add the coordinates of the original center back onto every coordinate. This puts the center back where it orginally was, but the figure is now scaled outward from it.

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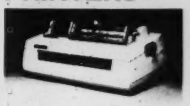

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Rotations

Rotations, like scaling, require a center. When we talk of direction, we'll use that of the part of the object closest to you (when the front rotates to the left, for example, the back goes to the right—we'll call this a left rotation). Rotations can be on any of three axes. Going around the x-axis rotates the object left or right, like a revolving door. Rotating around the z-axis moves the object clockwise or counterclockwise, like (gasp!) the hands of a clock.

Anyway, if a rotation on the z-axis is used as an example, the z-coordinates all stay the same. (Clockwise/counterclockwise doesn't affect the depth of any point.) Pretend your object is a two-dimensional figure, since the z-coordinate is never involved. The X and Y coordinates change according to some old formulas from trigonometry. The formulas have to do with the sine and cosine of the angle of rotation; for short we'll say S=sin(a) and C=cos(a), where "a" is the angle:

```
new X = C * X - S * Y
new Y = C * Y + S * X
(new Z = Z)
```

Since this rotation is on the z-axis, the figure will move clockwise or counterclockwise on the screen, depending on the angle of rotation. A small, positive angle causes counterclockwise movement.

Similarly, rotations around the y-axis (left/right) have no effect on the y-coordinate (height of the object on the screen). Again using S and C for the sine and cosine of the angle of rotation, the formulas would be:

```
new X = C * X - S * Z
new Z = C * Z + S * X
```

The other possibility, a rotation around the x-axis, gives an up/down movement of the object. In this case the x-coordinate is unaffected. The formulas are:

```
new Y = C * Y - S * Z
new Z = C * Z + S * Y
```

If you're studying these equations, note that the plusses and minuses in the equations depend on the direction to which you assign positive angles. This is because the opposite of an angle has the same cosine (cos(-a)=cos(a)), but the opposite sine (sin(-a)=-sin(a)). In this program, down, left, and clockwise are assigned negative angles, and up, right, and counterclockwise are assigned positive angles. This is all handled internally; the program user simply specifies the direction (see lines 6075-6110).

Before a rotation is done, however, we have to do the same operation with the center. Otherwise, rotations will move around the axes, rather than turning the object in its location. The first step is to subtract the center coordinates from all the coordinates of the object. The appropriate rotation formulas are then used, rotating the translated object around one of the axes. The final step is to add the center coordinates onto the new coordinates of the object, putting it back in its original location, but now rotated.

Distortions

There is one added operation in this program, called a distortion. A distortion is scaling an object in one dimension: width, height, or depth (the X, Y, or Z coordinate, respectively). This has the effect of stretching or compacting the object in that dimension. Starting with a cube, for example, you could distort each dimension, giving a rectangular box with any width, height, and depth. Thus, with a few basic shapes, you can create a multitude of variations without having to define new figures.

Designing the Program

The basic options necessary in this program will be creating and editing figures, viewing and manipulating them, saving them for later use, and loading previous figures. Other options included in this program are the ability to clear all figures from memory, for starting over, and saving two-dimensional screen images to disk.

A feature is also included to allow more than one figure to be in memory at a time. It is arranged so that several small figures can be created or loaded from disk and each one manipulated, assembling a larger figure consisting of all small figures in memory. This large figure can be saved, with all the small figures as its parts. The information from all the small figures is kept intact, so when the large figure is re-loaded, the small figures may still be manipulated individually.

To allow this capability, two extra arrays are needed: one to hold the names of the figures in memory, and one to hold the information for first and last point number, and first and last line number. The name array is FT$ in the program, and allows up to 100 names (0-99). The information array is dimensioned FG% (99,3). The '99' allows information for up to 100 figures. If 'I' is the number of the figure, (FG%(I,0) is the starting point of the figure, FG%(I,1) is the ending point, FG%(I,2) is the starting line, and FG%(I,3) is the ending line. An example of using these would be if Figure A had 8 points (0-7) and 12 lines (0-11), and Figure B had 4 points (8-11) and 4 lines (12-15). The starting point for Figure B is 8, the ending point 11, the starting line 12, and the ending line 15.

In the program, lines 5-86 initialize storage and give the main options to the user. LOMEM is set to 16384 so that the variables will not conflict with the high-resolution graphics page. In the array dimensions, T, X, and Y are used as temporary variables, and TR, the only other array not yet mentioned, will hold the values of the three-dimensional coordinates translated to two-dimensions.

All the subroutines dealing with creating, editing, loading, and saving would be considered housekeeping subroutines, separate from the part of the program that actually lets you view and manipulate figures. Those subroutines appear in lines 170-2020. Creating a new figure is done in lines 1000-2020, with the user first entering the points, then the lines. When done entering points (in X,Y,Z coordinates), the user types 'D' for "done." The point numbers for lines are then entered, again followed by "D" when finished.

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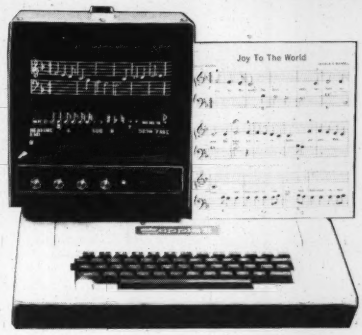

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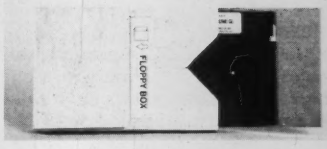

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The edit subroutine is in lines 170-239. This allows the user to display the points or lines for a figure, and change any of the values assigned to them. When first creating a figure, you may find it advantageous to enter a few "dummy" points to which you won't attach lines, in case you want to use them later. Likewise, you can enter a few dummy lines (connecting point 1 to point 1, for example) for possible later use.

Other subroutines in this section are: saving a figure (lines 250-288), loading a figure (lines 300-336), re-initializing the variables (line 350), and saving a screen image (lines 400-420).

There are a couple of other subroutines following these that let you choose figures for editing and manipulating, and compute information necessary for viewing. Lines 2830 to 2875 allow you to enter a figure name for editing and manipulation. Lines 2900-2930 allow you to specify manipulating everything on the screen, or an individual figure, setting the appropriate variables based on your replies. NP, NL, and NF are the number of points, lines, and figures. SP and EP are the numbers of the starting and ending points for the current figure, and SL and EL are the numbers of the starting and ending lines.

Viewing Figures

There are a few subroutines devoted exclusively to the process of viewing figures. Lines 120-165 control this process. First, the center and the viewer's distance must be computed. This is done in the subroutine in lines 2900-3140, as earlier explained. Then, in a loop, the following occur: the points are computed and translated, lines are drawn on the screen, the user selects an option for manipulating the figure, lines are erased, and the cycle starts over with the new points being computed, lines again drawn, etc. Each process is in its own subroutine. The points are computed and translated in lines 4000-4400. The loop in that subroutine goes from the starting point of the figure to the ending point, performs the selected operation on that point (C holds the operation code), then translates that point to its two-dimensional coordinate and stores that in the TR array. After every point has been done, the subroutine returns.

Lines 5000 to 5290 draw or erase the lines on the screen. SW and FS are switches that tell it which to do. If SW is set to zero, the subroutine erases each line. If FS is set to zero, the subroutine erases the entire screen and draws the new lines. If both SW and FS are equal to 1, then the subroutine only draws the new lines. (FS is 1 when only one figure of many is being moved; that way the other figures are not erased during movement.) This subroutine loops from the starting line to the ending line, determines the endpoints by checking array TR, then checks whether the line fits on the screen. The entire section from line 5070 to 5270 checks each endpoint for being on the screen, and attempts to find a segment of the line that will fit on the screen, if possible. This prevents trouble from parts of the figure that may be above, below, or to the side of the screen.

The last subroutine, where all the decisions are made, is in lines 6000 to 6300. Choices of operation are displayed here, and other decisions are made and constants gotten within this routine. For the sake of using this program, here's a breakdown of choices:

Rotate—allows rotation of the figure. You follow by giving a direction and an angle.

Shift—moves a figure. Again, you give a direction, then the number of units the figure should be moved.

Scale—changes the size of figure. You follow by giving a constant by which the dimensions will be multiplied. The constant may be a whole number or a decimal.

Distort—scales one dimension. You choose the dimension (width, height, or depth) and the constant by which to multiply.

Move Everything/One Figure—lets you choose to have further operations affect all figures in memory or just one. Choices are given to specify all, or a single figure name.

Choose Center—allows you to select your own center for rotations and scaling. Sometimes its advantageous to keep a specific point stationary, which happens with the center in rotate/scale operations. With this option you choose the point number of the center.

Edit, Save, or Quit—returns you to main options.

Full Screen—allows you to view full screen graphics until the next keypress.

Scale View on Screen—allows you to change the size of what you see without affecting the actual coordinates. It's like using binoculars instead of increasing the size of the object. This is also helpful for increasing or decreasing the illusion of perspective; similar to viewing an object closely (more apparent perspective) or from a distance (less apparent perspective). To get more "perspective," move the object very close and scale down the view on the screen. To get less 'perspective', move the object farther away and magnify it with this option.

This program should give you a good idea of how 3-D graphics are simulated by computers, the possible operations on them, and how those operations are performed. Questions regarding the program and the techniques are welcome, and I hope you enjoy it. □

```
1  REM 3-D GRAPHICS
     COPYRIGHT 1980
     MARK PELCZARSKI
5  LOMEM: 16384: HOME :D$ =  CHR$
   (4): HGR
50  DIM CR(2),T(2),X(1),Y(1),P(49
   9,2),L%(749,1),TR(499,1),FG%
   (99,3),FT$(99)
65  GOSUB 350
70  HOME : VTAB 21: PRINT "1-CREA
   TE FIGURE, 2-EDIT FIGURE": PRINT
   "3-VIEW, 4-START OVER": PRINT
   "5-SAVE ON DISK, 6-GET FROM
   DISK": PRINT "7-SAVE 2 DIMEN
   SIONAL IMAGE, 8-QUIT";
80  INPUT C: IF C < 1 OR C > 8 THEN
   70
81  IF C = 1 THEN 1000
82  IF C = 8 THEN  TEXT : STOP
83  IF NF > 0 THEN 85
84  IF C > 1 AND C < 6 THEN  PRINT
   : PRINT "THERE ARE NO FIGURE
   S IN MEMORY.": PRINT "(PRESS
    ANY KEY)": GET A$: GOTO 70

85  ON C GOSUB 5,170,120,350,250,
   300,400
86  GOTO 70
120  HGR :C = 1: GOSUB 2910
130  GOSUB 4000:SW = 1: GOSUB 500
   0: GOSUB 6000
155  IF FS = 1 THEN SW = 0: GOSUB
   5000
165  GOTO 130
170  GOSUB 2830:C1 = FG%(CF,0)
175  TEXT : HOME : PRINT FT$(CF)
180  PRINT "1-POINTS,2-LINES,3-CH
   ANGE,4-DONE EDITING": INPUT
   C: IF C < 1 OR C > 4 THEN 18
   0
185  ON C GOTO 190,205,220,239
190  PRINT "#,X,Y,Z:":SW = 1:S1 =
   0: FOR I = C1 TO FG%(CF,1)
194  PRINT I - C1 + 1;: FOR I1 =
   0 TO 2: HTAB 8 + I1 * 8: PRINT
    LEFT$ ( STR$ (P(I,I1)),6);:
    NEXT : PRINT :S1 = S1 + 1: IF
   S1 = 20 THEN  PRINT "(PRESS
   A KEY)": GET A$:S1 = 0: PRINT

196  NEXT : GOTO 180
205 C = FG%(CF,2): PRINT "#,FROM,
   TO":SW = 2:S1 = 0: FOR I = C
    TO FG%(CF,3)
212  PRINT I - C + 1,L%(I,0) - C1
    + 1,L%(I,1) - C1 + 1:S1 = S
   1 + 1: IF S1 = 20 THEN  PRINT
   "(PRESS A KEY)": GET A$:S1 =
   0: PRINT
214  NEXT : GOTO 180

220  IF SW = 2 THEN 230
222  INPUT "POINT #";I:I = I + C1
    - 1: IF I < C1 OR I > FG%(C
   F,1) THEN 180
224  INPUT "X:";P(I,0): INPUT "Y:
   ";P(I,1): INPUT "Z:";P(I,2):
    GOTO 180
230 C = FG%(CF,2): INPUT "LINE #"
   ;I:I = I + C - 1: IF I < C OR
   I > FG%(CF,3) THEN 180
232  INPUT "FROM #";L%(I,0): INPUT
   "TO #";L%(I,1): FOR I1 = 0 TO
   1:L%(I,I1) = L%(I,I1) + C1 -
   1: NEXT : GOTO 180
239  RETURN
250  INPUT "UNDER WHAT NAME? ";A$

255  PRINT D$;"OPEN";A$
260  PRINT D$;"WRITE";A$
261  PRINT NP: PRINT NL: PRINT NF
   : IF NF < 2 THEN 270
262  FOR I = 0 TO NF - 1: PRINT F
   T$(I): FOR I1 = 0 TO 3: PRINT
   FG%(I,I1): NEXT I1,I
270  FOR I = 0 TO NP - 1: FOR I1 =
   0 TO 2: PRINT P(I,I1): NEXT
   I1,I
```

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```
280  FOR I = 0 TO NL - 1: PRINT L
     %(I,0): PRINT L%(I,1): NEXT

286  PRINT D$;"CLOSE":A$
288  RETURN
300  ONERR  GOTO 302
301  INPUT "UNDER WHAT NAME?";A$:
     GOTO 304
302  PRINT A$;" WAS NOT FOUND ON
     DISK.": PRINT "<PRESS ANY KE
     Y>": GET A$: POKE 216,0: GOTO
     70
304  PRINT "DO YOU WANT TO KEEP "
     ;A$;" AS THE NAME":: INPUT F
     T$(NF)
305  IF  LEFT$ (FT$(NF),1) = "Y" THEN
     FT$(NF) = A$: GOTO 308
306  IF  LEFT$ (FT$(NF),1) <  > "
     N" THEN 304
307  INPUT "NEW NAME?";FT$(NF)
308  PRINT : PRINT D$;"OPEN";A$
309  PRINT D$;"READ";A$
310  INPUT T(0): INPUT T(1): INPUT
     T(2)
311  IF T(2) < 2 THEN 321
312  FOR I = NF + 1 TO NF + T(2)
313  INPUT FT$(I)
314  FOR I1 = 0 TO 1: INPUT FG%(I
     ,I1):FG%(I,I1) = FG%(I,I1) +
     NF: NEXT
317  FOR I1 = 2 TO 3: INPUT FG%(I
     ,I1):FG%(I,I1) = FG%(I,I1) +
     NL: NEXT I1,I
321  FOR I = NP TO NP + T(0) - 1:
      FOR I1 = 0 TO 2: INPUT P(I,
     I1): NEXT I1,I
325  FOR I = NL TO NL + T(1) - 1:
      FOR I1 = 0 TO 1: INPUT L%(I
     ,I1):L%(I,I1) = L%(I,I1) + N
     P: NEXT I1,I

331 FG%(NF,0) = NP:FG%(NF,1) = NP
     + T(0) - 1:NP = NP + T(0):F
     G%(NF,2) = NL:FG%(NF,3) = NL
     + T(1) - 1:NL = NL + T(1):C
     F = NF:NF = NF + T(2) + 1: IF
     T(2) = 1 THEN NF = NF - 1
334  PRINT D$;"CLOSE":A$
336  POKE 216,0: RETURN
350 NL = 0:NP = 0:NF = 0:VS = 0:C
     T = 3: RETURN
400  INPUT "UNDER WHAT NAME? ";A$

410  PRINT D$;"BSAVE";A$;",A8192,
     L8192"
420  RETURN
1000  HOME : TEXT :CF = NF:NF = N
     F + 1: INPUT "FIGURE NAME? "
     ;FT$(CF):FG%(CF,0) = NP:FG%(
     CF,2) = NL: PRINT "TYPE 'D'
     OR 'DONE' WHEN NO MORE POINT
     S.": ONERR  GOTO 1010
1010  PRINT "POINT #";NP - FG%(CF
     ,0) + 1: INPUT "X:";A$: IF  LEFT$
     (A$,1) = "D" THEN FG%(CF,1) =
     NP - 1: GOTO 2000
1015  IF  ASC (A$) > 57 THEN 1010

1020 P(NP,0) =  VAL (A$): INPUT "
     Y:";P(NP,1): INPUT "Z:";P(NP
     ,2):NP = NP + 1: GOTO 1010
2000  PRINT "TYPE 'D' OR 'DONE' W
     HEN NO MORE LINES.": ONERR  GOTO
     2010
2010  PRINT "LINE #";NL - FG%(CF,
     2) + 1: INPUT "FROM POINT #"
     ;A$: IF  LEFT$ (A$,1) = "D" THEN
     FG%(CF,3) = NL - 1: POKE 216
     ,0: GOTO 70
2015  IF  ASC (A$) > 57 THEN 2010

2020 L%(NL,0) =  VAL (A$): INPUT
     "TO POINT #";L%(NL,1): FOR I
     = 0 TO 1:L%(NL,I) = L%(NL,I
     ) + FG%(CF,0) - 1: NEXT :NL =
     NL + 1: GOTO 2010
2830  IF NF = 1 THEN CF = 0: RETURN

2845  INPUT "WHICH FIGURE? ";A$:I
     = 0
2855  IF FT$(I) = A$ THEN 2870
2860 I = I + 1: IF I < NF THEN 28
     55
2862  PRINT "YOU DON'T HAVE ONE H
     ERE NAMED ";A$: PRINT "<PRES
     S A KEY>":: GET A$: POP : RETURN

2870 CF = I
2875  RETURN
2900  IF NF < 2 THEN C = 1: GOTO
     2910
2905  INPUT "1-EVERYTHING, OR 2-I
     NDIVIDUAL FIGURE? ";C
2910  IF C = 1 THEN FS = 0:SP = 0
     :EP = NP - 1:SL = 0:EL = NL -
     1: GOTO 3032

2920  IF C <  > 2 THEN 2900
2930  GOSUB 2830:FS = 1:SP = FG%(
     CF,0):EP = FG%(CF,1):SL = FG
     %(CF,2):EL = FG%(CF,3)
3032  FOR I = 0 TO 2:CR(I) = 999:
     T(I) =  - 999: NEXT
3033  FOR I = SP TO EP
3034  FOR I1 = 0 TO 2
3035  IF P(I,I1) < CR(I1) THEN CR
     (I1) = P(I,I1)
3036  IF P(I,I1) > T(I1) THEN T(I
     1) = P(I,I1)
3037  NEXT I1,I
3038  FOR I = 0 TO 2:CR(I) = (CR(
     I) + T(I)) / 2: NEXT
3048  IF VS = 1 THEN 3140
3049 VS = 1:D1 = 0
3050  FOR I = SP TO EP
3060 VZ = 0: FOR I1 = 0 TO 2:VZ =
     VZ + (CR(I1) - P(I,I1)) ^ 2:
     NEXT :VZ =  SQR (VZ)
3110  IF VZ > D1 THEN D1 = VZ
3120  NEXT
3130 VZ =  - 20 * D1
3140 C = 4: RETURN
4000  FOR I = SP TO EP
4101  IF C = 4 THEN 4380
4102  FOR I1 = 0 TO 2:P(I,I1) = P
     (I,I1) - CR(I1):T(I1) = P(I,
     I1): NEXT
4110  ON C GOTO 4130,4200,4280,43
     80,4300
4130 T(1) = C1 * P(I,1) - S1 * P(
     I,2):T(2) = C1 * P(I,2) + S1
      * P(I,1): GOTO 4350
4200 T(0) = C1 * P(I,0) - S1 * P(
     I,2):T(2) = C1 * P(I,2) + S1
      * P(I,0): GOTO 4350
4280 T(0) = C1 * P(I,0) - S1 * P(
     I,1):T(1) = C1 * P(I,1) + S1
      * P(I,0): GOTO 4350
4300  IF S1 <  > 0 THEN T(S1 - 1)
     = P(I,S1 - 1) * M: GOTO 435
     0
4305  FOR I1 = 0 TO 2:T(I1) = P(I
     ,I1) * M: NEXT
4350  FOR I1 = 0 TO 2:P(I,I1) = T
     (I1) + CR(I1): NEXT
4380  IF VZ - P(I,2) >  - .001 THEN
     K = 10000 * D1: GOTO 4390
4385 K = VZ / (VZ - P(I,2))
4390 TR(I,0) = K * P(I,0):TR(I,1)
     = K * P(I,1)
4400  NEXT : RETURN
5000  IF SW = 0 THEN  HCOLOR= 0: GOTO
     5010
5005  IF FS = 0 THEN  HGR
5006  HCOLOR= 7
5010  FOR I = SL TO EL
5020 SW = 0
5030  FOR I1 = 0 TO 1
5035  IF L%(I,I1) < 0 OR L%(I,I1)
     >= NP THEN SW = 1: GOTO 5
     060
5040 X(I1) = TR(L%(I,I1),0) * CT:
     Y(I1) = TR(L%(I,I1),1) * CT

5060  NEXT
5070  FOR I1 = 0 TO 1
5090  IF SW = 1 THEN 5270
5100  IF  ABS (X(I1)) <  = 139 THEN
     5190
5110  IF  ABS (Y(I1)) <  = 95 THEN
     5150
5120  IF Y(0) = Y(1) THEN 5230
5125 YC =  SGN (Y(I1)) * 95:XC =
     (YC - Y(1)) * (X(0) - X(1)) /
     (Y(0) - Y(1)) + X(1): IF  ABS
     (XC) <  = 139 THEN 5250
5150  IF X(0) = X(1) THEN 5230
5155 XC =  SGN (X(I1)) * 139:YC =
     (XC - X(1)) * (Y(0) - Y(1)) /
     (X(0) - X(1)) + Y(1): IF  ABS
     (YC) <  = 95 THEN 5250
5180  GOTO 5230
5190  IF  ABS (Y(I1)) <  = 95 THEN
     5270
5200  IF Y(0) = Y(1) THEN 5230
5205 YC =  SGN (Y(I1)) * 95:XC =
     (YC - Y(1)) * (X(0) - X(1)) /
     (Y(0) - Y(1)) + X(1): IF  ABS
     (XC) <  = 139 THEN 5250
5230 SW = 1: GOTO 5270
5250 X(I1) = XC:Y(I1) = YC
5270  NEXT
5280  IF SW = 0 THEN  HPLOT 1
     X(0),96 - Y(0) TO 140 + X(1
     ),96 - Y(1)
5290  NEXT : RETURN
6000  HOME : VTAB 21: PRINT "1-RO
     TATE, 2-SHIFT, 3-SCALE OBJEC
     T(S),": PRINT "4-DISTORT, 5-
     MOVE EVERYTHING/ONE FIGURE":
      PRINT "6-CHOOSE CENTER, 7-E
     DIT, SAVE, OR QUIT": PRINT "
     8-FULL SCREEN ";
6038  IF FS = 0 THEN  PRINT "9-SC
     ALE VIEW ON SCREEN ";
6040  INPUT C: IF FS = 0 AND C =
     9 THEN 6300
6050  ON C GOTO 6075,6142,6073,60
     71,6065,6200,6070,6250
6060  GOTO 6000
6065  GOSUB 2900: GOTO 6000
6070  POP : RETURN
6071  PRINT : INPUT "1-WIDTH, 2-H
     EIGHT, OR 3-DEPTH?";S1: IF S
     1 < 1 OR S1 > 3 THEN 6071
6073  IF C = 3 THEN S1 = 0
6074  INPUT "MULTIPLY BY? ";M:C =
     5: RETURN
6075  HOME : VTAB 21: PRINT "ROTA
     TE  1-DOWN, 2-UP, 3-LEFT, 4-
     RIGHT,": PRINT "5-CLOCKWISE,
      6-COUNTERCLOCKWISE ":: INPUT
     C: IF C < 1 OR C > 6 THEN 60
     75
6090  INPUT "ANGLE (0 - 180) ? ";
     AN: IF AN < 0 OR AN > 180 THEN
     6090
6110 AN = 3.14 * AN / 180: IF  INT
     (C / 2) * 2 <  > C THEN AN =
      - AN

6130 S1 =  SIN (AN):C1 =  COS (AN
     ):C =  INT ((C + 1) / 2): RETURN

6142  HOME : VTAB 21: PRINT "SHIF
     T  1-LEFT, 2-RIGHT, 3-DOWN,
     4-UP,": PRINT "5-CLOSER, 6-F
     ARTHER ":: INPUT C: IF C < 1
      OR C > 6 THEN 6142
6150  INPUT "HOW MANY UNITS? ";AN
     : IF  INT (C / 2) * 2 <  > C
      THEN AN =  - AN
6170 C =  INT ((C - 1) / 2):CR(C)
     = CR(C) + AN: FOR I = SP TO
     EP:P(I,C) = P(I,C) + AN: NEXT
     :C = 4: RETURN
6200  PRINT "POINT # (1-";EP - SP
     + 1;") ":: INPUT C: IF C <
     1 OR C > EP - SP + 1 THEN 62
     00
6210 C = C + SP - 1: FOR I = 0 TO
     2:CR(I) = P(C,I): NEXT : GOTO
     6000
6250  POKE  - 16302,0: GET A$: POKE
      - 16301,0: GOTO 6000
6300  INPUT "MULTIPLY BY? ";M:CT =
     CT * M:C = 4: RETURN
```

Why use their flexible discs:

Athana, BASF, Control Data, Dysan, IBM, Maxell, Nashua, Scotch, Shugart, Syncom, 3M, Verbatim or Wabash

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MEMOREX

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Flexible Disc 1s Single Headed Drives Single Density Media	IBM Compatible (128 B/S, 26 Sectors)	3060	1.99	473071	53428	800506	2305830	FD1-128	FD-1	740-0	S/A-100	15002	FD34-9000	F111111X	421602
	IBM Compatible (128 B/S, 26 Sectors) w/ W.P.N.	3062	2.04	–	–	–	–	–	–	740-0	–	–	FD34-9000	–	–
	IBM Compatible (128 B/S, 26 Sectors) w/ W.P.N. & Hub Ring	3064	2.39	–	–	–	–	–	–	–	–	–	FD34-9000	–	–
	IBM Compatible (128 B/S, 26 Sectors) REVERSIBLE	1729	3.19	473072	54431	–	–	–	FD-2	740-2-0	–	15150	FF34-9000	F121111X	–
	IBM System 6 Compatible	3066	2.04	473077	54561	800509	1669959	–	–	740-0-056	–	15003	FD60-9000	F116111X	–
	IBM Compatible (256 B/S, 15 Sectors)	3109	1.99	473073	–	800584	2305845	–	–	740-3600	–	15005	FD36-9000	F112111X	–
	IBM Compatible (512 B/S, 8 Sectors)	3110	1.99	473074	–	800585	1669954	–	–	–	–	15004	FD60-9000	F113111X	–
	Shugart Compatible, 32 Hard Sector	3015	1.99	470901	53802	101/1	–	FH1-32	FD-132	740-32	S/A-101	15025	FD32-9000	–	421322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3087	2.49	–	54491	–	–	–	–	740-32RH	–	–	–	F37A411X	–
	CPT 8000 Compatible	3045	2.69	–	–	–	–	–	–	–	–	15226	–	–	–
Flexible Disc 1d Single Headed Drives Double Density Media	IBM Compatible (128 B/S, 26 Sectors)	3090	2.69	474071	54568	3740/1D	–	FD1-128/M2100	FD-1D	741-0	–	–	FD34-8000	F131111X	423002
	Soft Sector (128 B/S, 26 Sectors) REVERSIBLE	3093	3.69	–	–	–	–	–	–	–	–	–	–	–	–
	Shugart Compatible, 32 Hard Sector	3091	2.69	470801	54596	101/1D	–	FH1-32D	–	741-32	S/A-103	15075	FD32-8000	F33A411X	423322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3088	3.09	–	–	–	–	–	–	–	–	–	–	–	–
Flexible Disc 2s Double-Headed Drives Single Density Media	Soft Sector (128 B/S, 26 Sectors)	3113	3.09	–	54428	800814	1766870	–	–	–	S/A-150	15153	FD10-4026	F121111X	–
	Soft Sector (256 B/S, 15 Sectors)	3106	3.09	473477	54226	800815	2736700	FD2-256D	–	742-0	–	15154	FD10-4015	F122111X	424612
Flexible Disc 2d Double-Headed Drives Double-Density Media	Soft Sector (Unformatted)	3102	3.09	473485	–	DY150	–	FD2-XDM	FD-2D	743-0	–	15103	DD34-4001	–	425002
	Soft Sector (128 B/S, 26 Sectors)	3115	3.09	–	–	–	–	–	–	–	S/A-150	–	–	–	–
	Soft Sector (256 B/S, 26 Sectors)	3103	3.09	473471	54325	800817	1766872	FD2-256D	–	743-0/256	–	15101	DD34-4026	F144111X	425802
	Soft Sector (512 B/S, 15 Sectors)	3114	3.09	473472	54479	800818	1669044	–	–	743-0/512	–	15100	DD34-4015	F145111X	425612
	Soft Sector (1024 B/S, 8 Sectors)	3104	3.09	473473	54485	800819	1669045	–	–	743-0/1024	–	15102	DD34-4008	F147111X	425622
	32 Hard Sector	3105	3.09	470851	–	101/2D	–	FH2-32D	–	743-32	S/A-151	15125	DD32-4000	F344411X	425322
	Burroughs B-80 Compatible, 32 Hard Sector	3092	3.09	–	–	–	–	–	–	–	–	–	–	F34A611X	–
	Soft Sector (1024 B/S, 8 Sectors) w/ Hub Ring	3116	3.49	–	–	–	–	–	–	–	–	–	–	–	–
	Shugart Compatible, 32 Hard Sector	3181	3.39	–	–	–	–	–	–	–	–	–	DD32-4000	–	–
Flexible Disc FD Memorex 651 or Equiv. Drive Compatible	FD VI (Vinyl Jacket)	30712003	2.69	470651	–	FDIV	–	–	FD-165	511-0	–	15026	FD65-1000	F81A111X	–
Mini Flexible Disc 1s 5¼" Single Headed Drives Single Density Media	Soft Sector (Unformatted)	3401	1.94	475001	54256	104/1	–	MD1	MD-1	744-0	S/A-104	15300	MD525-01	M11A211X	441002
	10 Hard Sector	3403	1.94	475010	54257	107/1	–	–	MD 110	744-10	S/A-107	15325	MD525-10	M41A211X	441102
	16 Hard Sector	3405	1.94	475016	54258	105/1	–	MH1	MD 116	744-16	S/A-105	15326	MD525-16	M51A211X	441162
	Soft Sector (Unformatted) w/Hub Ring	3431	2.14	–	–	–	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector, w/Hub Ring	3433	2.14	–	–	–	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector, w/Hub Ring	3435	2.14	–	–	–	–	–	–	–	–	–	MD525-16	–	–
Mini Flexible Disc 1d 5¼" Single Headed Drives Double-Density Media	Soft Sector (Unformatted)	3417	2.14	–	54646	104/1D	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector	3418	2.14	–	54649	107/1D	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector	3419	2.14	–	54652	105/1D	–	–	–	–	–	–	MD525-16	–	–
	Soft Sector (Unformatted) w/Hub Ring	3481	2.34	–	–	–	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector w/Hub Ring	3483	2.34	–	–	–	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector w/Hub Ring	3485	2.34	–	–	–	–	–	–	–	–	–	MD525-16	–	–
Mini Flexible Disc 2d 5¼" Double-Headed Drives Double Density Media	Soft Sector (Unformatted)	3421	2.59	–	54624	104/2D	–	–	–	–	S/A-154	–	MD550-01	–	–
	10 Hard Sector	3423	2.59	–	54627	107/2D	–	–	–	–	S/A-157	–	MD550-10	–	–
	16 Hard Sector	3425	2.59	–	54630	105/2D	–	–	–	–	S/A-155	–	MD550-16	–	–
	Soft Sector (Unformatted) w/Hub Ring	3491	2.79	–	–	–	–	–	–	–	–	–	MD550-01	–	–
	10 Hard Sector w/Hub Ring	3493	2.79	–	–	–	–	–	–	–	–	–	MD550-10	–	–
	16 Hard Sector w/Hub Ring	3495	2.79	–	–	–	–	–	–	–	–	–	MD550-16	–	–

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Graphics Conversion for the TRS-80, Apple, and PET

Richard Kaplan

He sat in the basement hunched over his computer for hours, ambitiously entering a listing of his favorite game. "Converting this program to my machine should be a snap," he thought. "After all, I'm already an old pro at Apple programming. How much different can a TRS-80 be?" Months of fruitless programming later, he surrendered to his computer. He had discovered the hard way just how bewildering program conversion can be to someone with a knowledge of only his own computer.

Graphics conversion is perhaps one of the most frustrating problems with which a microcomputer owner must deal. To an Apple owner, the command "PRINT @ 1000, A + B" might seem like a way of instructing his computer to wait until ten o'clock before printing A + B. By the same token, a TRS-80 owner is just as likely to be able to decipher the meaning of the command "HGR" as he is likely to know offhand the Hungarian word for "disk drive."

But nowhere in the Apple owner's manual can he discover the meaning of PRINT @. Thus, very often, extremely competent programmers find themselves totally out of luck when translating programs for their machines.

This article will deal with the Apple II, the TRS-80 Models I and III, and the PET. In many cases it is possible to translate graphics for one machine directly to another, just as one translates foreign languages. However, there are many situations in which it is quite unrealistic to attempt direct conversion.

At those times, the best approach is to begin by finding out exactly what each graphics function in the program from which you are translating actually does. If you can plot each point on paper, then often it will be possible to modify the screen or devise an algorithm better suited to your computer. So, let's first take a look at the graphics capabilities of each computer.

APPLE

The Apple produces graphics in three ways: standard PRINT statements and two special graphics modes.

Any computer can produce graphics by printing characters on the screen. A simple bar graph, for instance, can easily be generated by drawing asterisks in the appropriate positions on the screen. The Apple provides two commands which greatly aid in developing programs of this nature and which will be very helpful in translating TRS-80 programs to the Apple.

The first step with "printed" graphics is to clear the screen. Typing HOME (or executing this statement from within a program in Applesoft) will accomplish this. If you have Integer Basic, the correct statement is CALL -936.

Any computer can produce graphics by printing characters on the screen.

VTAB and HTAB

The VTAB statement controls the location of the cursor along the Y axis. There are 24 lines on which the Apple can print in Text mode. Typing VTAB XX, where XX is any number from 1 to 24, will move the cursor to that location without erasing any previous characters. As an example, suppose we had executed the following: FOR I=1 to 12:PRINT"HELLO":NEXT. Executing the statement VTAB5:PRINT "GOODBYE" would cause the "HELLO" on the fifth line to be replaced with "GOODBYE."

This same principle can be used with horizontal tabbing. Typing HTAB XX, where XX is any number from 1 to 40, will move the cursor to the appropriate horizontal position.

HTAB and VTAB can be very useful when converting other programs to the Apple, especially when used in conjunction with the other special functions.

PEEK (37) contains a number, which can range from 0 to 23, holding the value of the vertical position of the cursor. This number is one *less* than the value for the same line if used in a VTAB statement. If the cursor is on line 10 and you wish to move the cursor up one position, the command VTAB PEEK(37) will do just that. HTAB PEEK(36) or HTAB POS(0) will do the same horizontally, i.e. move the cursor back one position. Caution should be exercised, however, not to HTAB to a position less than 1 or greater than 40, or to VTAB to a position less than 1 or greater than 24.

Although using ordinary PRINT statements is a very primitive means of programming graphics, in some cases it may be the best and most direct method to use in converting a program. In situations involving more intricate graphics, however, you may wish to use one of the Apple graphics modes.

The Apple has two graphics modes. These modes allow the use of as many as sixteen colo s, as well as some very powerful plotting statements. The only disadvantage to using the Apple graphics modes is that text and graphics cannot be mixed on the same area of the screen without tremendous programming effort. For most purposes the programmer is restricted to four lines of text at the bottom of the screen.

Lo-Res Graphics

Apple low-resolution graphics are very convenient for simple graphics programs. An array of graphics blocks 40 x 40 may be used, with four lines of text at the bottom. A 40 x 48 array is possible without text. Sixteen colors are available with lo-res graphics.

Typing GR (or using this from within a program) enters the lo-res mode (mixed text-graphics.) The screen is cleared to black and PRINT statements produce output only on the bottom four lines of text.

If you want the larger (40 x 48) graphics area, simply type POKE -16302,0. The four lines of text at the bottom disappear and you have an additional eight lines of graphics to work with on the bottom of the screen.

Before plotting any points, the Apple must be assigned a specific color. Sixteen colors are available. To assign a color to graphics, type COLOR=X, where X is

Richard Kaplan, 53 Capral Lane, New City, NY 10956.

any of the following: 0 black, 1 magenta, 2 dark blue, 3 purple, 4 dark green, 5 grey, 6 medium blue, 7 light blue, 8 brown, 9 orange, 10 grey, 11 pink, 12 green, 13 yellow, 14 aqua, 15 white.

Assigning a color has no effect on graphics already on the screen. Only graphics statements executed after this will be of that color. Therefore, executing several color statements allows multiple colors to be used on the same screen.

Apple Low-Resolution Graphics are very convenient for simple graphics programs.

Now for a very basic question: How do you plot a point? Basically, the Apple screen operates similarly to a mathematical coordinate system. The X axis can be pictured as running along the top of the screen, numbered with coordinates from 0 to 39. The Y axis runs parallel to the left side of the screen, with 0 at the top and 39 or 47 at the bottom, depending on whether you have chosen to use the extra eight lines or not. Thus the point 0,0 is at the top left of the screen and the point 39,39 is at the bottom right of the screen (in mixed text-graphics mode).

The PLOT statement actually plots a specific point. Its format is PLOT X,Y. Thus PLOT 20,20 would place a graphics square at a location 20 points away from the left of the screen and twenty points down from the top. To erase this point, set the color to 0 (black) or whatever the background color is and re-plot the point.

It is also possible with the Apple to draw a line between two points on the screen. The command HLIN X,Y AT Z would plot a horizontal line between horizontal coordinates X and Y at vertical location Z. Thus the statement HLIN 1,20 AT 10 would connect the points 1,10 and 20,10. VLIN X,Y at Z does the same thing for a vertical line. Thus, the command VLIN 1,20 AT 10 would connect the points 10,1 and 10,20.

For an example of lo-res graphics see the program in Figure 1 which shows a border around the lo-res screen.

As a last note to using lo-res graphics, the user should know how to exit this mode. Simply type TEXT and the screen will revert to its usual 24 lines of text and 40 characters per line.

Hi-Res Graphics

The Apple high-resolution graphics mode offers some of the best graphics capabilities available on any microcomputer. Although only eight colors can be used, resolution of 280 x 192 pixels may be obtained, allowing highly detailed objects and extremely impressive graphics to be programmed.

To enter hi-res graphics, simply type HGR. This gives you a 280 x 160 grid with four lines of text at the bottom. Typing HGR2 instead of HGR, or typing POKE -16302,0 after entering HGR, will place

Figure 1.

```
10 GR                    Enter lo-res graphics mode
20 COLOR = 3             Set color to be purple
30 HLIN 0,39 AT 0        Draw line at top of screen
40 VLIN 0,39 AT 39       Draw line at right of screen
50 HLIN 0,39 at 39       Draw line at bottom of screen
60 VLIN 0,39 AT 0        Draw line at left of screen
```


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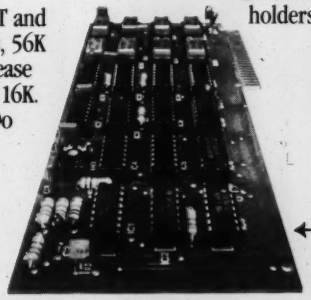

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Figure 2.

```
10 HGR                                          Enter hi-res graphics mode
20 COLOR = 1                                    Set color to green
30 HPLOT 0,0 TO 0,159 TO 279,159 TO 279,0 TO 0,0   Connect the four corners of the screen
```

you in the full-screen graphics mode, with a resolution of 280 x 192.

The high-resolution colors are set very similarly to low-resolution colors. HCOLOR= is the equivalent of the lo-res statement COLOR=. The eight colors available in high resolution graphics are: 0 black, 1 green, 2 blue, 3 white 1, 4 black, 5 depends on TV, 6 depends on TV, 7 white 2.

The hi-res coordinate system is numbered from 0 to 279 along the X axis (top of the screen) and from 0 to 159 (HGR) or 0 to 191 (HGR2) along the Y axis.

The hi-res equivalent of PLOT is HPLOT. HPLOT X,Y plots a point at location X on the X axis and location Y on the Y axis.

In high-resolution graphics, it is possible to plot from any location to any other location, even if it necessitates the drawing of a diagonal line. The statement HPLOT X,Y TO X,Y or HPLOT X,Y TO X,Y TO X,Y TO X,Y connects the points between the "TO." This is a very powerful statement, and it is not available in lo-res mode.

TRS-80 graphics are much simpler than Apple graphics, although not quite as versatile.

For an example of Apple hi-res graphics, see the program in Figure 2 which draws a border around the screen, as in the last example.

As with lo-res graphics, TEXT will cause the computer to revert to normal text mode.

TRS-80

TRS-80 graphics are much simpler than Apple graphics, although not quite as versatile. No special graphics modes are required. Text may be printed at a specific location on the screen (as with the Apple VTAB and HTAB statements), and graphics may be used on the same screen. The resolution of the TRS-80 may be compared to the Apple lo-res mode.

The Model I and the Model III are almost identical machines; 95% of TRS-80 statements can be used on both machines. For this reason, I will use "TRS-80" to refer to both models. When a specific feature is available on only one model, I will specify that model.

PRINT Statements

The TRS-80, like the Apple, can produce graphics through PRINT statements. However, the TRS-80 has a special statement, PRINT @, which makes it possible to refer to any screen location specifically by number. This can be a very powerful statement if used efficiently.

The Model III TRS-80 has a set of 96 additional special characters.

The TRS-80 screen is composed of 16 lines of 64 characters each, for a total of 1024 possible character positions. These positions are numbered from 0 to 1023, with 0 in the upper left of the screen, 63 at the end of the first line, 64 at the beginning of the second line, etc., and 1023 as the last position in the last line of the screen. The correct syntax for this statement is PRINT @ XXXX,... where XXXX is a number from 0 to 1023 and ... is any expression valid in a standard PRINT statement.

Let's go back to the example we used with the Apple. First type FOR I = 1 to 12:PRINT"HELLO":NEXT. In order to replace the fifth "HELLO" on the Apple with "GOODBYE" we typed VTAB 5: PRINT"GOODBYE". On the TRS-80, however, the best way to accomplish the same thing is to identify the numerical value of the first location on the fifth line of the screen.

The formula (X-1)*64 is used to locate the point at which to print if you wish to begin printing at the first position on the Xth line of the screen. Therefore, in order to print "HELLO" twelve times and replace the fifth with "GOODBYE," we would type: FORI=1to12:PRINT"HELLO": NEXT:PRINT@(5-1)*64,"GOODBYE". Note, though, that the cursor location has been moved to the fifth line of the screen, so that the word "READY" will now print where a "HELLO" formerly was. If you did not wish this to happen, you could add PRINT@(13-1)*64,"; which would move the cursor location back down to the thirteenth line.

Very often in converting graphics, you will want to move the cursor up or down one column without using a PRINT @ statement. Maybe you do not know the current cursor position, or perhaps you are converting a PET program which uses a special PET feature to relocate the cursor. To do this on the TRS-80 you would use the CHR$ function. Typing PRINT CHR$(X); where X is one of several special cursor movement codes, will perform the desired action. The codes are listed in Table 1.

Table 1.

CHR$(X) X-Value	Action
24	Move cursor one space left
25	Move cursor one space right
26	Move cursor one line down
27	Move cursor one line up
28	Move cursor to upper-left corner

Graphics Characters

The TRS-80 can also create graphics by printing special graphics characters. These characters (see Figure 3) consist of all 64 possible on/off permutations of a 2 x 3 matrix ($2^{2^3} = 2^6 = 64$). These graphics characters may be printed by using the CHR$ function. Typing PRINT CHR$(X), where X is the numerical code for the special graphics character desired, prints that character. This function can also be used in conjunction with the PRINT @ statement. In addition, the statement PRINT STRING$ (X,Y) will print a string composed of graphics character Y concatenated with itself X times. Thus, the statement PRINT @0,STRING$(64,191) will print a horizontal line across the top of the screen.

The Model III TRS-80 has a set of 96 additional special characters. Sixty-four

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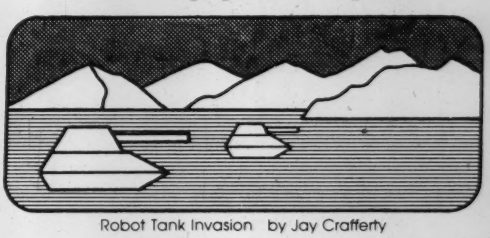

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Figure 3. TRS-80 graphics characters (codes 128-191).

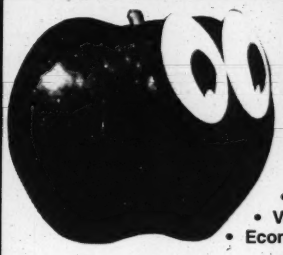
DEC	HEX	Z-80 OP CODE	GRAPHIC	TRS-80 BASIC
128	80	ADD A,B		END
129	81	ADD A,C		FOR
130	82	ADD A,D	80 81 82 83	RESET
131	83	ADD A,E		SET
132	84	ADD A,H		CLS
133	85	ADD A,L		CMD
134	86	ADD A,(HL)	84 85 86 87	RANDOM
135	87	ADD A,A		NEXT
136	88	ADC A,B		DATA
137	89	ADC A,C		INPUT
138	8A	ADC A,D	88 89 8A 8B	DIM
139	8B	ADC A,E		READ
140	8C	ADC A,H		LET
141	8D	ADC A,L		GOTO
142	8E	ADC A,(HL)	8C 8D 8E 8F	RUN
143	8F	ADC A,A		IF
144	90	SUB B		RESTORE
145	91	SUB C		GOSUB
146	92	SUB D	90 91 92 93	RETURN
147	93	SUB E		REM
148	94	SUB H		STOP
149	95	SUB L		ELSE
150	96	SUB (HL)	94 95 96 97	TRON
151	97	SUB A		TROFF
152	98	SBC A,B		DEFSTR
153	99	SBC A,C		DEFINT
154	9A	SBC A,D	98 99 9A 9B	DEFSNG
155	9B	SBC A,E		DEFDBL
156	9C	SBC A,H		LINE
157	9D	SBC A,L		EDIT
158	9E	SBC A,(HL)	9C 9D 9E 9F	ERROR
159	9F	SBC A,A		RESUME
160	A0	AND B		OUT
161	A1	AND C		ON
162	A2	AND D	A0 A1 A2 A3	OPEN
163	A3	AND E		FIELD
164	A4	AND H		GET
165	A5	AND L		PUT
166	A6	AND (HL)	A4 A5 A6 A7	CLOSE
167	A7	AND A		LOAD
168	A8	XOR B		MERGE
169	A9	XOR C		NAME
170	AA	XOR D	A8 A9 AA AB	KILL
171	AB	XOR E		LSET
172	AC	XOR H		RSET
173	AD	XOR L		SAVE
174	AE	XOR (HL)	AC AD AE AF	SYSTEM
175	AF	XOR A		LPRINT
176	B0	OR B		DEF
177	B1	OR C		POKE
178	B2	OR D	B0 B1 B2 B3	PRINT
179	B3	OR E		CONT
180	B4	OR H		LIST
181	B5	OR L		LLIST
182	B6	OR (HL)	B4 B5 B6 B7	DELETE
183	B7	OR A		AUTO
184	B8	CP B		CLEAR
185	B9	CP C		CLOAD
186	BA	CP D		CSAVE
187	BB	CP E	B8 B9 BA BB	NEW
188	BC	CP H		TAB(
189	BD	CP L		TO
190	BE	CP (HL)		FN
191	BF	CP A	BC BD BE BF	USING

of these can be printed exactly as the 64 described above. They are codes 192-255 (see Figure 4). However, there is one short statement which must be executed prior to printing these characters.

When the Model III is powered up, these 64 codes represent "space compression" characters. PRINT CHR$(192) prints no spaces, PRINT CHR$(193) prints one space, etc., until PRINT CHR$(255), which would print 63 spaces. In order to replace these space compression characters with the special graphics characters, type PRINT CHR$(21). This statement functions as a toggle switch between space compression characters and special graphics characters.

In addition to the 64 special graphics characters available to the Model III owner, there exists a special set of Japanese characters. These characters are CHR$ numbers 192-255, as are the special graphics characters. They are selected by executing the statement PRINT CHR$(22) after

Figure 4. TRS-80 Model III special characters (codes 0-31, 192-255).



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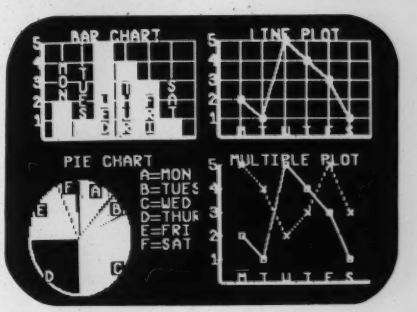

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selecting the special character set (PRINT CHR$(21)).

If you are amazed at the number of characters available on the Model III, you are in for still another surprise. There is yet another set of special graphics characters available to the Model III user. These characters are codes 0-31 (see Figure 4). However, they are only accessible by means of a POKE statement.

In order to print a graphics character from 0 to 31, the value of that character must be poked into the appropriate memory location, or what Radio Shack refers to as VIDRAM. These video addresses start at 15360 and end at 16383, and are equivalent to a PRINT @ address plus 15360. Thus, in order to print special character 10 at the beginning of the screen, you would type "POKE 15360,10."

We are not done yet with the TRS-80 graphics capabilities. Both models can also plot specific points on the screen. These plotted points can appear on the screen in conjunction with any other graphics features on the TRS-80, as well as text.

The TRS-80 screen is divided into a 128 x 48 array, any block of which may simply be turned on or off. Color is not supported by either TRS-80.

The statement SET (X,Y) turns on the graphics block at horizontal location X (X axis) and vertical location Y (Y axis). The X value can be between 0 and 127, while the Y value can range from 0 to 47. An important difference between turning on a graphics block and printing a graphics character is that a graphics block will not scroll off the screen. The only way to eliminate it is through the RESET statement or clearing the screen, which is done with CLS.

The RESET statement, as previously stated, turns off the specified graphics block. The syntax of the statement is RESET (X,Y), and it has exactly the same parameters as does the SET statement.

See Figure 5 for an example demonstrating some basic characteristics of TRS-80 graphics.

PET

PET graphics are very different from TRS-80 graphics. There are no special graphics modes on the PET, nor can a specific point on the screen be referred to by means of a coordinate system. Essentially PET graphics consist of standard PRINT statements combined with special cursor movement characters. (The graphics characters which may be printed are accessed by pressing the Shift key and the appropriate keyboard key. The cursor movement keys are specifically marked, and sometimes must be pressed in conjunction with the Shift key.)

The PET has six cursor movement characters. These characters are treated just like any other character on the keyboard, as they may be assigned to a string variable and printed. When they are printed, they appear as special symbols, quite unique from any character on any other computer.

The Home Cursor key returns the cursor to the upper lefthand corner of the screen. It is printed as an "S" in reverse video.

The shifted Home Cursor key returns the cursor to the upper lefthand corner of the screen and also clears the screen. It appears on the screen as a heart in reverse video.

The Cursor Down/Up key moves the cursor down one line. It appears as a "Q" in reverse video.

The shifted Cursor Down/Up key moves the cursor up one line. It appears as an empty circle with a black border.

The Cursor Right/Left key moves the cursor one position to the right. It appears as a right bracket in reverse video.

The shifted Cursor Right/Left key moves the cursor one position to the left. It appears as a black rectangle with a vertical white line through it.

These six cursor control characters can be treated just like any other character in the PET character set. For example, the sequence PRINT "(Shifted Home Cursor) (Cursor Down) (Cursor Down) (Cursor Down) HELLO" would clear the screen and place the word "HELLO" on the fourth line.

There are no special graphics modes on the PET.

The PET also has an alternate set of characters, which can be selected by typing POKE 59468,14. The keyboard will then function with the alternate character set (see Figure 6). To return to the standard character set, execute the statement POKE 59468,12.

The program in Figure 7, though quite simple, illustrates the basic method of incorporating graphics into a PET program. The program clears the screen, moves the cursor to the fourth line, and draws a square.

CONVERSION TO APPLE

From TRS-80

When converting a program from the TRS-80 to the Apple, you may use the text mode, low-resolution graphics, or high-resolution graphics.

TEXT mode should be used when the original program involves PRINT @ statements, or simply PRINT statements, and the text or graphics on the screen can be condensed to 40 columns wide. Aside from the smaller screen, the only disadvantage to using the Apple will be that graphics characters cannot be generated in text mode.

The statement causing the most confusion in conversion is probably PRINT @. However, this is really the easiest statement to convert. The TRS-80 statement PRINT @ X, "THIS IS A TEST" can be changed into three Apple statements:

```
VTAB INT(X/64) + 1
HTAB X + 1 - INT(X/64) * 64
PRINT "THIS IS A TEST"
```

When using this conversion procedure, however, the user must be very cautious not to HTAB past column 40. The TRS-80 screen is 64 columns wide, in contrast to the 40-column screen of the Apple. If only 40 columns are needed, then this procedure

Figure 5.

```
10  CLS                                  Clear screen
20  FOR X = 0 to 127:SET (X,47):         Draw a border around the screen
    SET (X,0):NEXT
    FOR X=0 to 47:SET (0,X):SET(127,
    X):NEXT
30  PRINT @512,"Press ENTER to see       Print message at center of screen
    special characters";
40  INPUT"";X$                           Wait for Enter key
50  CLS                                  Clear screen
60  PRINT CHR$(21)                       Select graphics characters
70  FOR I=192 to 255:                    Print characters
    PRINT CHR$(I):" ";:NEXT
80  INPUT"PRESS ENTER TO SEE             Wait for Enter
    Japanese characters";X$
90  PRINT CHR$(22)                       Select Japanese characters
100 INPUT "PRESS ENTER TO                Wait for Enter
    END@;X$
110 PRINT CHR$(22);CHR(21);:             Select standard character sets
    CLS:END                              Clear screen
```

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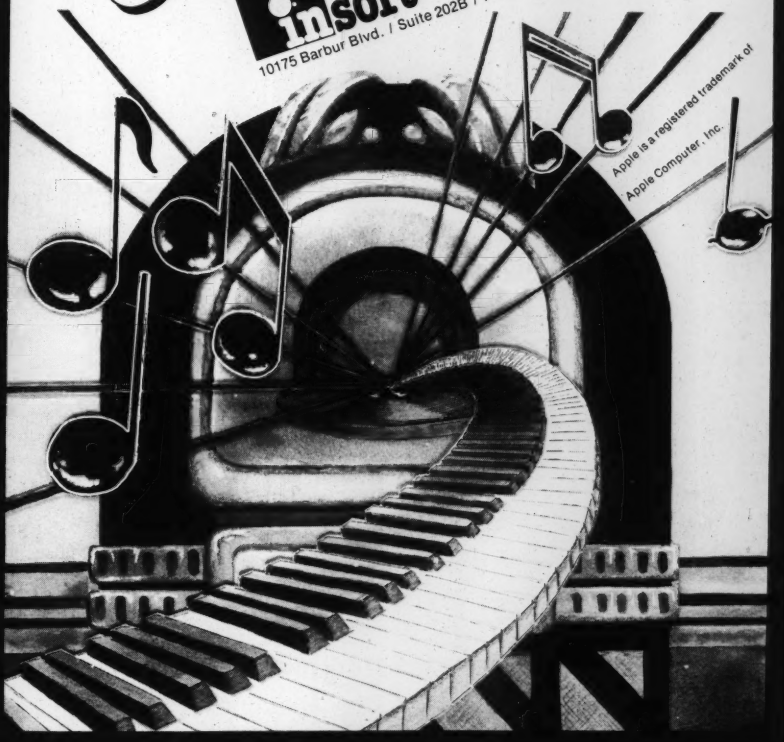

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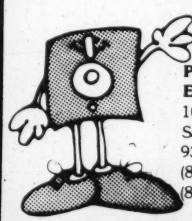

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Figure 6. PET standard and alternate character sets.

PRINTS	CHR$	PRINTS	CHR$	PRINTS	CHR$	PRINTS	CHR$
	0		16	SPACE	32	ø	48
	1	CRSR ↓	17	!	33	1	49
	2	RVS ON	18	"	34	2	50
	3	CLR HOME	19	#	35	3	51
	4	INST DEL	20	$	36	4	52
WHT	5		21	%	37	5	53
	6		22	&	38	6	54
	7		23	'	39	7	55
	8		24	(	40	8	56
	9		25	)	41	9	57
	10		26	*	42	:	58
	11		27	+	43	;	59
	12	RED	28	,	44	<	60
RETURN	13	CRSR →	29	-	45	=	61
SWITCH TO LOWER CASE	14	GRN	30	.	46	>	62
	15	BLU	31	/	47	?	63
@	64	U	85		106		127
A	65	V	86		107		128
B	66	W	87		108		129
C	67	X	88		109		130
D	68	Y	89		110		131
E	69	Z	90		111		132
F	70	[	91		112	f1	133
G	71	£	92		113	f3	134

PRINTS	CHR$	PRINTS	CHR$	PRINTS	CHR$	PRINTS	CHR$
H	72	]	93		114	f5	135
I	73	↑	94		115	f7	136
J	74	←	95		111	f2	137
K	75		96		117	f4	138
L	76		97		118	f6	139
M	77		98		119	f8	140
N	78		99		120	SHIFT RETURN	141
O	79		100		121	SWITCH TO UPPER CASE	142
P	80		101		122		143
Q	81		102		123	BLK	144
R	82		103		124	CRSR ↑	145
S	83		104		125	RVS OFF	146
T	84		105		126	CLR HOME	147
INST DEL	148	CYN	159		170		181
	149	SPACE	160		171		182
	150		161		172		183
	151		162		173		184
	152		163		174		185
	153		164		175		186
	154		165		176		187
	155		166		177		188
PUR	156		167		178		189
CRSR ←	157		168		179		190
YEL	158		169		180		191

Figure 7.

```
10 PRINT"(CLEAR SCREEN)                  Clear screen and move cursor
   (CURSOR DOWN) (CURSOR                 down to fourth line
   DOWN) (CURSOR DOWN)";
20 PRINT"------"                         Draw top of square
30 FOR I = 1 TO 7:                       Draw sides of square
   PRINT"      ":NEXT
40 PRINT"------"                         Draw bottom of square
```

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is probably the easiest to use. It might be advisable, however, to plot out on graph paper the results of the PRINT @ statements to obtain more aesthetically pleasing results.

The easiest conversion between TRS-80 and Apple (in TEXT mode) is clearing the screen. Essentially all that must be done is to replace every occurrence of CLS in a TRS-80 program with HOME.

The TRS-80 graphics should be simulated in either lo-res or hi-res graphics. These methods will provide the most graphically pleasing results. However, if text and graphics must be placed on the same screen, then TEXT mode must be used. In this case, you should follow the instructions under lo-res graphics, but substituting HOME for GR (in order to clear the screen but not enter the graphics mode).

PLOT statements, when used from TEXT mode, will not place graphics blocks at the appropriate coordinates, but will instead place standard text characters on the screen. The actual character which will be printed can be predetermined, but that is beyond the scope of this article.

The TRS-80 statement PRINT CHR$(31) will clear the screen from the current cursor position on. This can be emulated on the Apple by executing the statement CALL -958.

The TRS-80 special graphics characters (including the alternate character sets of the Model III) cannot be easily duplicated on the Apple. If you have a program which mixes text and special graphics characters, the only options available are to substitute characters from the Apple standard character set or use hi-res graphics and create a character generator, which is a most formidable task for an inexperienced programmer.

Apple lo-res graphics can be used when only graphics are used on the TRS-80 (SET statements), as opposed to text and graphics. But remember, lo-res offers at best a 40 x 48 array (with no text), while the TRS-80 has a 128 x 48 array of graphics. However, if it is possible to program a particular application within these constraints then lo-res graphics are preferable. Lo-res is easier to use than hi-res and provides twice as many colors from which to choose.

Using lo-res again requires condensing the TRS-80 screen. In this case, the graphics must be condensed to either 40 x 48 or 40 x 40. Once this has been done, the conversion procedure is quite simple.

In the TRS-80 program, look to see where the graphics portion begins. Usually a CLS statement will appear at this point. Replace the CLS with GR to clear the screen and enter lo-res mode.

Subsequent PRINT statements in the program will have to be restricted to four lines of text. These lines of text must be contiguous at the bottom of the screen. No special conversion of PRINT statements is required unless PRINT @ is used. In that case, keep in mind that only lines 21-24 may be used for text in lo-res graphics.

If you wish to replace the bottom four lines of text with an additional eight rows of graphics, execute the statement POKE -16302,0. You will then have a 40 x 48 array available.

A color should be selected before any points are plotted. (This color may be changed at any point in the program without changing previously plotted graphics.) This is done through the COLOR= statement (see above).

All SET statements should be replaced with PLOT statements. Essentially, SET (X,Y) becomes PLOT X,Y. Not all acceptable values for X and Y in a SET statement are valid values in a PLOT statement. X in a PLOT statement cannot exceed 39, and Y cannot exceed either 39 or 47, depending upon whether full screen graphics or mixed text-graphics is chosen.

The final step is to convert the TRS-80 RESET statements. This is done exactly as a SET statement is converted, with one exception. The color should be set to whatever the background is (usually black). Then executing a PLOT statement will transform that graphics block back into its original state (off).

High-Resolution Graphics

Converting TRS-80 graphics to hi-res graphics is much more involved than converting to TEXT mode or lo-res graphics, but the results are well worth the effort. The entire 128 x 48 grid can be incorporated into the Apple screen, along with all 64 graphics characters (ASCII codes 128-191). The alternate character sets of the Model III can also be simulated, though this requires substantial programming effort in some cases.

Before discussing the actual conversion process, let's take a closer look at the graphics capabilities of the TRS-80. We have said that the screen is a 128 x 48 array. But is this really so? In actuality, each graphics block is, itself, an array two blocks wide and three blocks high. This means that the TRS-80 graphics screen can be represented as a screen of (128 * 2) * (48 * 3), or 256 * 144, blocks. The Apple high resolution mixed text-graphics mode can accommodate 280 * 160 blocks, so the entire TRS-80 screen can in fact, be represented on the Apple.

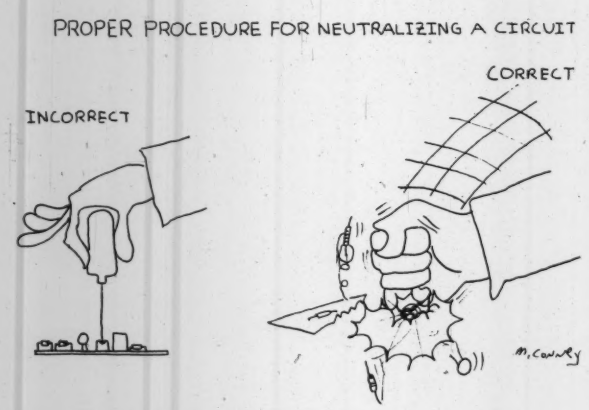
If you have been following along, you will probably have noticed that there is one small problem with this conversion procedure. The TRS-80 screen, you will recall, is composed of 6144 blocks. The portion of the Apple screen we will use, however, contains 256 * 144, or 36,864, blocks. This means we will have to plot 36864/6144, or 6, points on the Apple for every point on the TRS-80. The way to do this follows.

First, select the hi-res graphics mode appropriate for your application (HGR or HGR2). Usually HGR will be sufficient, because even with the extra lines of text at the bottom of the screen there is enough room to accommodate the full TRS-80 screen.

The next step is to select a color with the HCOLOR= statement. This can be done by simply choosing a color from the chart in this article.

Whenever you encounter a SET (X,Y) statement, it must be converted into the equivalent HPLOT statements. The X and Y coordinates of the SET statements can be related to the Apple screen. The coordinates X * 2, Y * 3 correspond to the upper left point of the Apple 2 * 3 grid for that point. See Table 2 for a list of the six points on the Apple which compose that one point.

If the entire block is to be filled in, you should execute the statements HPLOT X * 2,Y * 3 TO X * 2,Y * 3 + 2:HPLOT X * 2 + 1,Y * 3 TO X * 2 + 1, Y * 3 + 2. It is a



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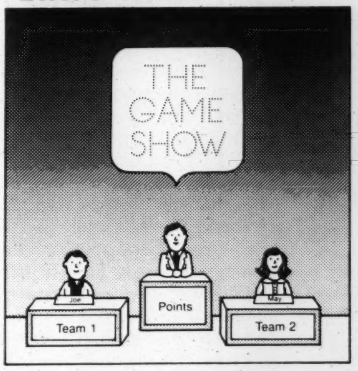

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good idea to incorporate these statements into a subroutine. Then, any time a statement such as SET (2,3) appears in your source listing, you can simply substitute the statements X = 2:Y = 3:GOSUB 10000 (assuming you have used the above line of code as line 10000 and added a RETURN statement at the end).

Plotting one of the 64 TRS-80 graphics characters is very simple. First consult the chart to determine which of the six graphics blocks should be turned on or off. Then apply the formulas in the above chart and HPLOT the appropriate coordinates.

For example, let's say we wanted to print character 179. By examining the chart, we can see that this is composed of the top left, top right, bottom left, and bottom right portions of the 2 x 3 graphics grid. If we wanted to print this at TRS-80 coordinates (50,100), we would execute the following statements:

```
HPLOT 50 * 2+1,100 * 3 + 2
HPLOT 50 * 2,100 * 3 + 2
HPLOT 50 * 2+1,100 * 3
HPLOT 50 * 2,100 * 3
```

From PET

Converting PET graphics to the Apple can be exceedingly frustrating if the PET special graphics characters are used. Producing many of these on the Apple is comparable to producing the Model III special character sets. In many cases it is advisable to rewrite the entire programming algorithm so that it is more adaptable to use on the Apple.

Converting PET graphics to the Apple can be exceedingly frustrating.

If the graphics characters used on the PET are such that there is a comparable character in the Apple character set, then conversion is very easy. The PET screen is composed of 25 lines of 40 characters each, and the Apple screen contains 24 lines of 40 characters. The hardest part of the conversion is simply reducing the screen to 24 lines, which can usually be accomplished without much problem.

The main problem in converting between the PET and the Apple is substituting appropriate VTAB and HTAB statements for the cursor movement characters on the PET. This can usually be done directly using Table 3.

Table 2.

Apple X Value	Apple Y Value	Position
X * 2	Y * 3	Upper Left
X * 2 + 1	Y * 3	Upper Right
X * 2	Y * 3 + 1	Middle Left
X * 2 + 1	Y * 3 + 1	Middle Right
X * 2	Y * 3 + 2	Lower Left
X * 2 + 1	Y * 3 + 2	Lower Right

Table 3.

PET Cursor Control Character	Apple Cursor Location Statement
Home Cursor	VTAB 1:HTAB 1
Shifted Home Cursor (Clear Screen)	HOME
Cursor Down/Up	VTAB PEEK (37) + 2
Shifted Cursor Down/Up	VTAB PEEK (37)
Cursor Right/Left	HTAB PEEK (36) + 2
Shifted Cursor Right/Left	HTAB PEEK (36)

Table 4.

PET Character	Apple Statement	Function
Reverse On	Inverse	Print all subsequent characters in reverse video
Shifted Reverse On	Normal	Cancel all reverse video statements previously executed

Now, let's say we have a PET program which clears the screen and draws a line on the fifth line of the screen. The program would have a statement which read PRINT" (Shifted Home Cursor) (Cursor Down/Up) (Cursor Down/Up) (Cursor Down/Up) (Cursor Down/Up) ..." The translated Apple program would read HOME:VTAB PEEK (37)+2:VTABPEEK(37)+2:VTAB PEEK (37)+2:VTAB PEEK(37)+2:PRINT"..." Note that the cursor location characters on the PET are actually part of the PET character set and thus are PRINTed as elements of a string literal (or even a string variable). The Apple, on the other hand, has cursor movement *statements* which *cannot* be used from within PRINT statements.

Both the PET and Apple support reverse video. On the PET, there are two special characters, which, again, can be used from within a string and PRINTed. On the Apple, there are separate statements to control this function. The appropriate commands are shown in Table 4.

The methods which the PET and the Apple incorporate to access reverse video are quite similar. Executing the appropriate statement causes all subsequent output to be printed in reverse video. There is one small difference, however. The Apple INVERSE statement can *only* be cancelled by a NORMAL statement. On the PET, either a carriage return *or* a Shifted Reverse on will do it.

Let's say the PET program you are translating has the statement PRINT "(Reverse On) THIS IS IN REVERSE FIELD (Shifted Reverse On) AND THIS IS NOT". The equivalent Apple statements would be INVERSE:PRINT"THIS IS IN REVERSE FIELD ";:NORMAL:PRINT "AND THIS IS NOT". Note the use of a semicolon after the first PRINT statement to cancel the carriage return.

CONVERSION TO TRS-80

From Apple

Conversion to TRS-80 from the Apple, when possible, is very easy. Most printed output from the Apple can be duplicated on the TRS-80, but since the TRS-80 screen only has 16 lines, whereas the Apple screen has 24 lines, in some cases the screen must be compressed or modified in some other way.

Only two of the three Apple "modes" can be emulated on the TRS-80. PRINTed output (VTAB, HTAB, etc.) can be easily converted, as can Apple lo-res graphics. The TRS-80 does not, however, have the ability to reproduce Apple high resolution graphics. If a hi-res graphics program must be converted to the TRS-80, the standard TRS-80 graphics must be used, and a substantial amount of resolution will be lost.

The only potential problem in converting an Apple program to the TRS-80 is in

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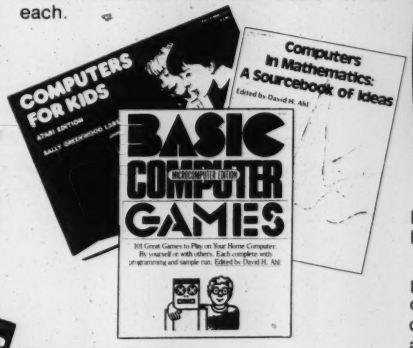

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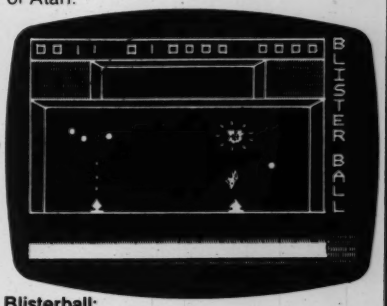

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locating the equivalent PRINT @ location for a given set of VTAB and HTAB locations. For any given values X and Y, the Apple statement VTAB X:HTAB Y is equivalent to the TRS-80 expression PRINT @ (X * 64) + Y -65. One problem with using this method, however, is that since the TRS-80 screen only has 16 lines of text, this formula cannot be used in a situation where the X value is greater than 16. The only solution to this problem is to redesign the screen so that only 16 lines of text are used.

Another element in converting an Apple program to the TRS-80 is clearing the screen. Quite simply, replace each occurrence of HOME in the Apple program with a CLS in the TRS-80 version.

Apple lo-res graphics can be duplicated very easily on the TRS-80. Since the Apple lo-res screen contains at most a 40 x 48 matrix and the TRS-80 screen has a 128 x 48 matrix, this particular conversion is ideal.

When you encounter a GR statement, replace it with CLS. Then, simply replace each occurrence of PLOT X,Y with SET (X,Y). The actual values of X and Y will not change in this instance.

Color cannot be reproduced on the TRS-80, so COLOR= statements should be ignored, except where the COLOR is set to 0 or whatever the background color is at that moment. In that case, subsequent PLOT statements should be replaced with RESET statements in order to erase the graphics blocks at the appropriate coordinates.

From PET

Converting a PET program to run on the TRS-80 is similar to converting it to run on the Apple. However, the screen will have to be reduced not to 24 lines from the PET's 25, but to 16 lines. In addition, many of the PET special characters have no parallels on the TRS-80. If no acceptable character can be found on the TRS-80, the only solution is to plot out the individual points from the PET program and devise an algorithm to access TRS-80 SET statements or to PRINT TRS-80 special graphics characters.

When converting from the PET to the TRS-80, cursor control characters on the PET will probably cause the most confusion. These cursor control characters, however, have *direct* equivalents on the TRS-80, as shown in Table 5.

In order to access the TRS-80 codes, you should use the CHR$ function and PRINT the appropriate character. (Be sure to place a semicolon after the PRINT statement.) Thus, the equivalent of the PET statement PRINT"(Home Cursor) (Cursor Down/Up) (Cursor Right/Left) TEST" would be PRINT CHR$(28);CHR$(26);CHR$(25);"TEST".

With the PET there is no way to access a particular screen location directly with a set of coordinates.

One PET character does not have an ASCII counterpart on the TRS-80. The Shifted Home Cursor on the PET (which clears the screen) should be replaced with the CLS on the TRS-80.

CONVERSION TO PET

From Apple

Converting a program from Apple to PET is, in many cases, almost impossible. The graphics capabilities of the PET simply operate very differently from those of most other computers.

The main problem in converting graphics from the Apple to the PET is that with the PET there is no way to access a particular screen location directly with a set of coordinates, such as Apple VTAB and HTAB statements or the TRS-80 PRINT @ statement. The best advice to PET owners is to rewrite the graphics routines of their programs in order to reproduce graphics efficiently.

There is a way to create a subroutine to simulate VTAB and HTAB statements, but it is generally not advisable unless relatively simple graphics are being used. It can be used with PRINTed graphics only, lo-res and hi-res graphics cannot be directly translated.

Essentially, we must first home the cursor then print as many Cursor Downs as the value of the argument of the VTAB minus 1 and as many Cursor Rights as the value of the argument of the HTAB statement minus 1. Thus, the statement VTAB 4: HTAB4;PRINT"THIS IS A TEST" can be translated as PRINT "(Home Cursor) (Cursor Down/Up) (Cursor Down/Up) (Cursor Down/Up) (Cursor Right/Left) (Cursor Right/Left) (Cursor Right/Left) THIS IS A TEST". By incorporating a FOR-NEXT loop, this can be made into a subroutine. While it is a very primitive means of duplicating a VTAB statement, it is a possibility for relatively simple PET graphics programs.

The one other necessary conversion between the Apple and the PET is the clear screen code. On the PET, the equivalent statement would be PRINT"(Shifted Home Cursor)".

From TRS-80

Converting a program from the TRS-80 to the PET is basically the same as converting an Apple program to the PET. It is exceedingly difficult to do, and the resulting program will not usually operate very efficiently if the same algorithm is used with both programs.

The clear screen code on the TRS-80 is CLS. This means that every occurrence of CLS in the TRS-80 program should be replaced with PRINT"(Shifted Home Cursor)".

If it is absolutely necessary to convert a TRS-80 program to the PET directly, it can be done. However, as with the Apple, only TEXT can be directly translated. This means that a graphics program which uses SET statements can usually *not* be translated.

PRINT @ statements are the primary means of producing graphics on the TRS-80 without SET statements. The PRINT @ address must first be converted into an equivalent set of horizontal and vertical coordinates. For any given PRINT @ coordinate X, the corresponding vertical (Y axis) coordinate is INT (X/64) + 1 and the horizontal coordinate is X + 1 - INT (X/64) * 64. Once these coordinates have been computed, the procedure above for Apple to PET conversion can be followed to move the cursor.

The graphics conversion techniques described here do not exhaust all possible conversion methods, nor have I covered every graphics statement on every computer mentioned. What I have attempted to do is familiarize the reader with the basic graphics principles of each computer and provide some insight as to how to approach the conversion process.

Graphics conversion is by no means an objective endeavor; once he has an understanding of how each computer operates the programmer's own creativity will more than likely influence his conversion technique more than anything else. □

Table 5.

PET Cursor Control Character	TRS-80 ASCII Code
Home Cursor	28
Cursor Down/Up	26
Shifted Cursor Down/Up	27
Cursor Right/Left	25
Shifted Cursor Right/Left	24

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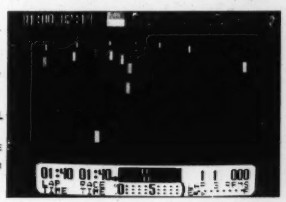

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Player/Missile Design Aid

Tom Gurak

Player/Missile Design Aid (PMDA) is a program which aids you in designing your own player/missile graphics. Player/missile graphics are a powerful tool provided by Atari for designing games. However, designing and encoding each player/missile character can be a time-consuming process. Further, using the normal method of designing these players on graph paper, the designer is never sure exactly how the player/missile graphic will look when displayed on the screen.

Player/Missile Design Aid was written to facilitate this process and allow the designer to see the player/missile graphic he is designing while he is working on it.

Whenever PMDA is awaiting your direction, it shows a blinking cursor on the screen. To move the cursor, simply push the joystick in the direction you wish to move the cursor. The cursor will continue to move in that direction until you release the joystick or push it in a different direction.

To start, LOAD the PMDA program and type RUN. PMDA will then display a title screen and begin setting up. Once setup is complete, PMDA displays a screen containing an 8 x 24 bit map which will be used to design your player graphic.

Note that a bit which is off (0) is displayed as a plus sign (+) and a bit which is on (1) is displayed as a solid white block. To the immediate left of the bit map is a column of line numbers and to the right is the decimal POKE value for each line. Initially, this latter field is all zeroes. As bits are turned on, however, this will change to correspond to the new value of the line (byte).

Tom Gurak, 24 North St., West Albany, NY 12205.

On the right side of the screen is a list of commands, a status line, and a prompt line which indicates the action to be taken.

Some explanation of the status line is in order. The first item is the current player/missile mode (M=nn). The two digits are the actual decimal value which is POKEd at SDMCTL (559) to produce the desired mode. M=46 indicates that you are in double-line mode (the default); M=62 indicates that you are in single-line mode.

The second item is the player size or width (W=n). The digit following is the desired value to be POKEd in the player size register (in this case, SIZEP0 (53256)). W=0 indicates single width (the default); W=1 indicates double width; and W=3 indicates quadruple width. The last item is the color/luminance for the player/missile graphic (COLOR=). The digits following are the actual decimal POKE value in the player/missile color register (in this case, PCOLR0 (704)).

I would like to point out that I am not attempting to explain player/missile graphics as there has been much information published already on this subject. I am merely attempting to present enough information to enable you to understand the operation of the Player/Missile Design Aid.

Finally, we are ready to begin designing our player/missile graphic. Using the joystick, position the blinking cursor to the bit position in the map which is to be changed. Pushing the fire button on the joystick will cause the bit to be flipped from off to on, or vice-versa. As bits are turned on, the actual player/missile graphic will begin to take shape in the area between the bit map display and the command list.

It is also possible to "draw" a line in any direction. To accomplish this, position the cursor to the desired starting position of the line, press and *hold* the fire button, and push the joystick in the desired direction. Remember that if you pass over a bit position which is already on, it will be turned off.

To use the commands (each of which is described later), position the cursor to the first character of the desired command and press the fire button. The command list may be reached by moving the cursor to the left or right until it leaves the bit map display. To return the cursor to the bit map, simply move the joystick left or right.

When the player/missile graphic is completed and all options (mode, width, and color) are set correctly, you can either write down the status line settings and the decimal values for each line (byte) of the player/missile graphic or you can use the Save Data command to save this data. The data saved takes the form of a Basic language DATA statement which may be added to your own player/missile graphic program by using the Atari ENTER command. This eliminates the need for a runtime subroutine to load the data. The format of the DATA statement is explained later.

Commands

Shift All ↑: Shifts all 24 lines of the graphic up one line and leaves a blank (0) line at line 23.

Shift All ↓: Shifts all 24 lines of the graphic down one line and leaves a blank (0) line at line 0.

Shift All →: Shifts all 24 lines of the graphic right one bit position and leaves a

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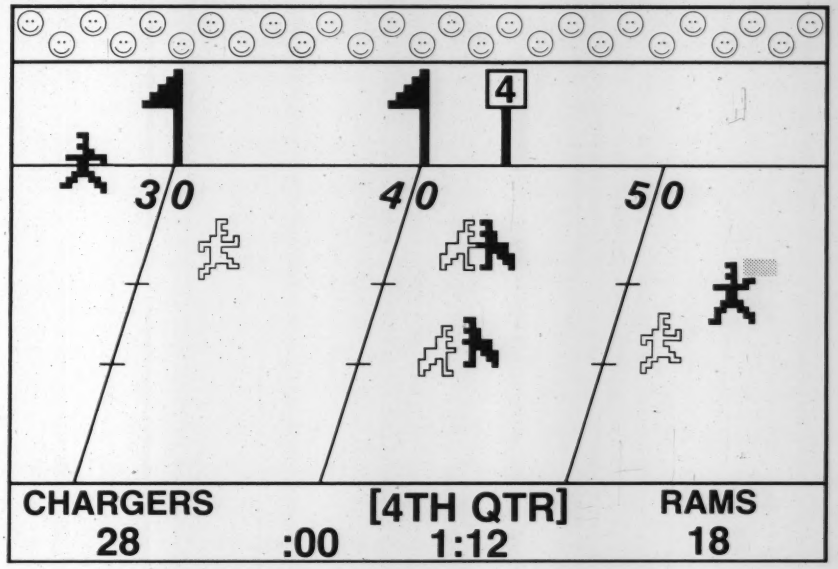

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blank (0) column of bit positions at the extreme left.

Shift All ←: Shifts all 24 lines of the graphic left one bit position and leaves a blank (0) column of bit positions at the extreme right.

Shift Line ↑ : Shifts all lines from the line you indicate to line 23 up one line and leaves a blank line (0) at line 23. Select the first line to be shifted by positioning the cursor on the desired line and pressing the fire button when prompted by the program.

Shift Line ↓ : Shifts all lines from the line you indicate to line 23 down one line and leaves a blank (0) line at the line selected. Line selection is the same as described for Shift Line ↑ above.

Shift Line →: The single line which you select is shifted right one bit position and a 0 bit is left at the extreme left of the line. Line selection is the same as for Shift Line ↑.

Shift Line ←: The single line which you select is shifted left one bit position and a 0 bit is left at the extreme right of the line. Line selection is the same as for Shift Line ↑.

Blank All: All bit positions are set to 0. Before proceeding, you will be asked to confirm your request by pressing the fire button. If you do not want the command to proceed, push the joystick in any direction.

Blank Line: The single line which you select will have all its bit positions set to 0. Line selection is as described for Shift Line ↑.

Blank Column: The bit position which you select will be set to 0 in all lines. Select the bit position by moving the cursor to the desired position and pressing the fire button when prompted by the program.

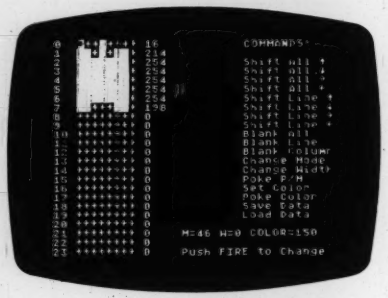
Change Mode: This changes the mode from double-line (M=46) to single-line (M=62) and vice-versa.

Change Width: This changes the player/missile graphic width from single (W=0) to double (W=1); double to quadruple (W=3); or quadruple to single.

POKE P/M: This allows the user to enter a previously-defined character when only the POKE values are known. Use the keyboard to enter the value for each line when prompted by the program. The Return key must be pressed after each value. Enter three nines (999) followed by Return to indicate that you are done.

Set Color: This sets the color of the player/missile graphic *only*. Using the keyboard, enter the Atari color value (0-15) followed by Return, then enter the luminance value (0-14, even numbers only) also followed by Return. These values will be converted to the corresponding color register value and POKEd into PCOLR0 to change the color of the player/missile graphic displayed.

POKE Color: This sets the color of the player/missile graphic *only*. Using the keyboard, enter the decimal value to be POKEd into the player/missile color register.



Tank.

Save Data: This saves the player/missile data as a Basic language DATA statement. The format on this statement is described later. Prior to beginning the operation, you are asked to confirm your intent by pushing the fire button. To cancel the operation, push the joystick in any direction. The data saved include the mode, width, and color settings followed by the POKE values for each line from 0 to the last non-zero line.

Load Data: This loads previously-saved player/missile data. Before beginning the operation, you are asked to confirm your intent by pressing the fire button. To cancel the operation, push the joystick in any direction. Upon confirmation, a Blank All operation will be performed. The player/missile graphic will be loaded and displayed with the same mode, width, and color as were in effect when it was saved.

Messages

Color?: Use the keyboard to enter the Atari color value and press the Return key.

Enter POKE Values: Use the keyboard to enter the POKE values for a play/missile graphic. Press Return after each one and use 999 followed by Return to indicate you are finished.

Luminance?: Use the keyboard to enter the Atari luminance value and press Return.

No P/M Data to Save: The Save Data command was selected but there are no non-zero bits in the bit map. No action is required.

POKE Color?: Use the keyboard to enter the POKE value for the player/missile color register and press the Return key.

Pos Cursor for Blank: Position the cursor to the line/column to be blanked and press the fire button to complete the Blank command.

Pos Cursor for Shift: Position the cursor to the appropriate line for the Shift operation and press the fire button to complete the Shift command.

Processing...: A long-running command is executing. No action is required.

Push FIRE to Change: The cursor is located within the bit map and pressing the fire button will cause the bit at the cursor position to be flipped.

Push FIRE to Confirm: A Blank All, Save Data, or Load Data command has been selected and pressing the fire button will cause the command to continue. The command may be cancelled by pushing the joystick in any direction.

Push FIRE to Select: The cursor is located within the command list and pressing the fire button will cause the command at which the cursor is positioned to be executed.

Ready Tape Recorder: Insert a cassette tape, press Play or Record and Play depending on the operation selected, and press the console Return key.

Save Data Format

The Save Data command produces a Basic language DATA statement which has the following format:

Lineno DATA mode, width, color, data0, data1,...datan,-1

Lineno is the line number. The first save will create a statement with a line number of 32000. For each subsequent save, the line number is incremented by 10.

DATA is written as shown to identify the Basic language statement type.

Mode is the POKE value for the player/missile mode (double-line or single-line).

Width is the POKE value for the player/missile size register.

Color is the POKE value for the player/missile color register.

Data0 is the POKE value needed to create line 0 of the player/missile graphic.

Data1 is the POKE value needed to create line 1 of the player/missile graphic.

Datan is the POKE value needed to create line n of the player/missile graphic. The last line saved is the last non-zero line found in the bit map. Leading zero lines and any zero lines within the body of the player/missile graphic *will* be saved.

-1 is written as shown to indicate the end of the player/missile data. □

```
5 TRAM=PEEK(106)-8:POKE 106,TRAM
10 GRAPHICS 2+16:SETCOLOR 4,9,4:? #6:? #
6:? #6;"   PLAYER/MISSILE":? #6
20 ? #6;"      DESIGN AID":? #6:? #6:? #6
;"        -BY-":? #6:? #6;"      TOM  GUR
AK"
30 K0=0:K1=1:K2=2:K5=5:K7=7:K8=8:K10=10:
K12=12:K13=13:K15=15:K19=19:K22=22:K23=2
3:K27=27:K256=256:K512=512
40 ATRACT=77:SDMCTL=559:PCOLR0=704:CRSIN
H=752:HPOSP0=53248:SIZEP0=53256:GRACTL=5
3277:PMADR=54279
70 PMBASE=TRAM*K256+K512
```

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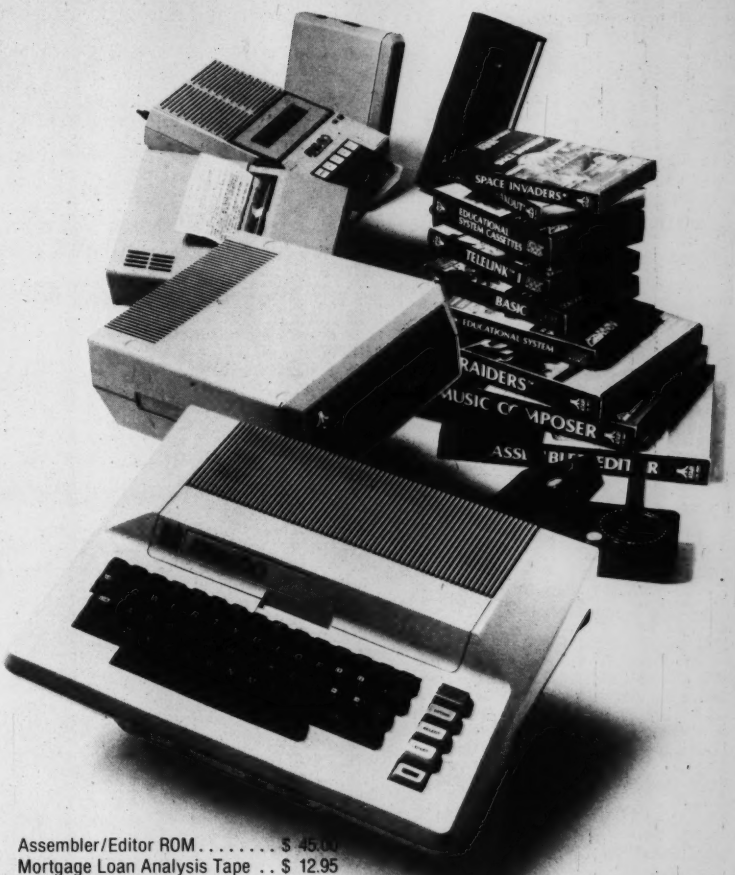

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```
 80 FOR Y=PMBASE TO PMBASE+768:POKE Y,K0:
NEXT Y
 90 POKE PMADR,TRAM:PMBASE=PMBASE+34
100 DIM B$(1),I$(1),S$(6),A$(4),L$(5),C$
(6):B$="+":I$="Inverse Video Blank":S$="
Shift ":A$="All ":L$="Line ":C$="Blank "
110 SN=31990:WD=0:MS=46
120 DIM P$(13),Q$(15),T$(7):P$="Push FIR
E to ":Q$="Pos Cursor for "
140 FOR W=K0 TO K256%K10:NEXT W
150 GRAPHICS K0:SETCOLOR K2,K0,K0:SETCOL
OR K1,K12,K12:POKE CRSINH,K1:? " ";
160 POKE SDMCTL,MS:POKE PCOLR0,K12:POKE
GRACTL,3:POKE HPOSP0,119
170 GOSUB 1000
200 POKE ATRACT,K0:LOCATE X+K5,Y,OC:H=12
8:CC=OC+H
210 POSITION X+K5,Y:? CHR$(CC);:H=-H:CC=
CC+H:FOR W=K0 TO K23:NEXT W:P=STICK(K0):
T=STRIG(K0)
215 IF P=K15 AND T THEN 210
220 POSITION X+K5,Y:? CHR$(OC);:IF T THE
N 300
222 IF CSW THEN GOTO CRT
225 IF X=K22 THEN 400
230 CC=ASC(B$):IF OC=CC THEN CC=ASC(I$)
240 POSITION X+K5,Y:? CHR$(CC);:A=PMBASE
+Y:PM=PEEK(A):WM=INT(K2^(K7-X)+0.5):IF O
C=ASC(B$) THEN PM=PM+WM:GOTO 260
250 PM=PM-WM
260 WY=Y:GOSUB 800
270 IF P<>K15 THEN 300
280 P=STICK(K0):IF  NOT STRIG(K0) THEN 2
70
300 XC=K0:YC=K0:IF P>K8 AND P<K12 THEN X
C=-K1:GOTO 320
310 IF P>4 AND P<K8 THEN XC=K1
320 IF P=6 OR P=K10 OR P=14 THEN YC=-K1:
GOTO 335
330 IF P=K5 OR P=9 OR P=K13 THEN YC=K1
335 IF X=K22 AND XC AND YC THEN YC=K0
340 X=X+XC:Y=Y+YC
343 IF CSW THEN GOTO CRT
345 IF X<K8 AND X>=K0 THEN 365
350 IF X=K22 THEN 380
355 IF X=21 OR X=K23 THEN X=K0:Y=K0:GOSU
B 1100:GOTO 200
357 IF  NOT STRIG(K0) THEN 357
360 X=K22:Y=K2:GOSUB 1150:GOTO 200
365 IF Y>K23 THEN Y=K0:GOTO 200
370 IF Y<K0 THEN Y=K23
375 GOTO 200
380 IF  NOT STRIG(K0) THEN 380
385 IF Y<K2 THEN Y=K19:GOTO 200
390 IF Y>K19 THEN Y=K2
395 GOTO 200
400 A=Y-K1:ON A GOTO 410,420,430,440,450
,460,470,480,490,500,510,2300,2200,1500,
900,1600,1700,1900
410 GOSUB 1200:YS=K0:YE=K23:YI=K1:GOTO 7
00
420 GOSUB 1200:YS=K23:YE=K0:YI=-K1:GOTO
700
430 GOSUB 1200:YS=K0:YE=K23:XS=K7:XE=K0:
XI=-K1:GOTO 750
440 GOSUB 1200:YS=K0:YE=K23:XS=K0:XE=K7:
XI=K1:GOTO 750
450 YI=K1:GOSUB 580:YS=YE-K1:YE=K23:GOTO
 700
460 YS=K23:YI=-K1:GOSUB 580:GOTO 700
470 XS=K7:XE=K0:XI=-K1:GOSUB 580:YS=YE:G
OTO 750
480 XS=K0:XE=K7:XI=K1:GOSUB 580:YS=YE:GO
TO 750
490 GOSUB 2500:GOSUB 1200:GOSUB 1000:GOT
O 200
500 GOSUB 590:GOTO 650
510 X=K0:Y=K0:T$=C$(K1,K5):GOSUB 1160:CS
W=K1:CRT=515:GOTO 200
515 Y=K0:IF  NOT T THEN 530
520 IF X>K7 THEN X=K0:GOTO 200
525 IF X<K0 THEN X=K7
527 GOTO 200
530 GOSUB 1200:WM=INT(K2^(K7-X)+0.5):FOR
 WY=K0 TO K23:LOCATE X+K5,WY,OC:IF OC=AS
C(B$) THEN 550
540 A=PMBASE+WY:PM=PEEK(A):PM=PM-WM:GOSU
B 800
550 POSITION X+K5,WY:? B$;:NEXT WY
570 CSW=K0:IF X=K22 THEN GOSUB 1150:GOTO
 200
575 GOSUB 1100:GOTO 200
580 T$=S$(K1,K5):GOTO 600
590 T$=C$(K1,K5)
600 X=K0:Y=K0:POSITION K19,K23:? Q$;T$;:
GOSUB 1300:CSW=K1:CRT=610:GOTO 200
610 X=K0:IF T THEN 365
620 YE=Y:GOSUB 1200:RETURN
650 POSITION K5,YE:FOR WX=K0 TO K7:? B$;
:NEXT WX
660 A=PMBASE+YE:WY=YE:PM=K0:GOSUB 800:GO
TO 570
700 FOR WY=YS TO YE-YI STEP YI:FOR WX=K0
 TO K7:LOCATE WX+K5,WY+YI,OC:POSITION WX
+K5,WY+YI:? CHR$(OC);
710 POSITION WX+K5,WY:? CHR$(OC);:NEXT W
X:A=PMBASE+WY:PM=PEEK(A+YI):GOSUB 800:NE
XT WY
720 GOTO 650
750 FOR WY=YS TO YE:FOR WX=XS TO XE-XI S
TEP XI
760 LOCATE WX+K5+XI,WY,OC:POSITION WX+K5
+XI,WY:? CHR$(OC);:POSITION WX+K5,WY:? C
HR$(OC);:NEXT WX
770 POSITION XE+K5,WY:? B$;:A=PMBASE+WY:
PM=PEEK(A):IF XI=-K1 THEN PM=INT(PM/K2):
GOTO 780
775 PM=PM%K2:IF PM>=K256 THEN PM=PM-K256
780 GOSUB 800:NEXT WY:GOTO 570
800 POKE A,PM:POSITION 14,WY:? PM;"  ";:
RETURN
900 GOSUB 990:? "Color";:GOSUB 1400:IF P
<K0 OR P>K15 OR P<>INT(P) THEN 900
910 A=P%16
920 GOSUB 990:? "Luminance";:GOSUB 1400:
IF P<K0 OR P>14 OR P<>INT(P/K2)%K2 THEN
920
930 A=A+P:POKE PCOLR0,A
940 GOSUB 950:GOTO 570
950 A=PEEK(PCOLR0):POSITION 28,21:? "COL
OR=";A;"  ";:RETURN
990 POSITION K19,K23:? "
    ";:POSITION K19,K23:RETURN
1000 FOR Y=K0 TO K23:POSITION K2,Y:? Y;:
FOR X=K0 TO K7:POSITION X+K5,Y:? B$;:NEX
T X
1010 A=PMBASE+Y:PM=K0:WY=Y:GOSUB 800:NEX
T Y
1020 POSITION K27,K0:? "COMMANDS:";
1030 POSITION K27,K2:? S$;A$;"Esc Esc Es
c Up-Arrow";:POSITION K27,3:? S$;A$;"Esc
 Esc Esc Down-Arrow";
1040 POSITION K27,4:? S$;A$;"Esc Esc Esc
 Right-Arrow";:POSITION K27,K5:? S$;A$;"
Esc Esc Esc Left-Arrow";
1050 POSITION K27,6:? S$;L$;"Esc Esc Esc
 Up-Arrow";:POSITION K27,K7:? S$;L$;"Esc
 Esc Esc Down-Arrow";
1060 POSITION K27,K8:? S$;L$;"Esc Esc Es
c Right-Arrow";:POSITION K27,9:? S$;L$;"
Esc Esc Esc Left-Arrow";
1072 POSITION K27,K13:? "Change Mode";
1075 POSITION K27,14:? "Change Width";:P
OSITION K27,K15:? "Poke P/M";
1080 POSITION K27,16:? "Set Color";:POSI
TION K27,17:? "Poke Color";
1090 POSITION K27,18:? "Save Data";:POSI
TION K27,19:? "Load Data";:GOSUB 2400:GO
SUB 2250:GOSUB 950
1095 IF CSW THEN RETURN
1100 T$="Change ":GOTO 1160
1150 T$="Select ":GOTO 1160
1160 POSITION K19,K23:? P$;T$;:GOSUB 130
0
1170 SOUND K0,K0,K0,K0:RETURN
1200 POSITION K19,K23:? "Processing";:FO
R W=K1 TO K10:? ".";:NEXT W:SOUND K0,250
,6,K2:RETURN
1300 SOUND K0,50,K12,4:FOR W=K0 TO K23:N
EXT W:SOUND K0,K0,K0,K0:RETURN
1400 P=K0:W=K0:OPEN #1,4,0,"K:":GOSUB 13
00:POKE CRSINH,K0:? "?";
1410 GET #1,W:IF W=155 THEN 1490
1420 IF W=126 THEN P=INT(P/K10):? "Esc L
eft-Arrow Space Esc Left-Arrow";:GOTO 14
10
1430 IF W>47 AND W<58 THEN P=P%K10+(W-48
):? CHR$(W);:GOTO 1410
1440 ? "Esc Ctl-Clear";:GOTO 1410
1490 CLOSE #1:POKE CRSINH,K1:? " ";:RETU
RN
1500 POSITION K19,K23:? "Enter Poke Valu
es   ";:FOR WY=K0 TO K23
1510 POSITION K13,WY:GOSUB 1400:IF P=999
 THEN 1590
1520 IF P<K0 OR P>=K256 THEN 1510
1530 PM=P:GOSUB 2100
1560 POSITION K13,WY:? " ";:NEXT WY:GOTO
 570
1590 A=PMBASE+WY:PM=PEEK(A):GOSUB 800:PO
SITION K13,WY:? " ";:POP :GOTO 570
1600 GOSUB 990:POSITION K19,K23:? "Poke
Color";:GOSUB 1400:IF P<K0 OR P>=K256 OR
 P<>INT(P/2)%2 THEN 1600
1610 A=0:GOTO 930
1700 FOR YE=K23 TO K0 STEP -K1:IF PEEK(P
MBASE+YE)<>K0 THEN 1720
1710 NEXT YE:POSITION K19,K23:? "No P/M
Data to Save ";:FOR W=K0 TO K512:NEXT W:
GOTO 570
1720 POP :GOSUB 2500:GOSUB 1790:A=K0
1730 OPEN #1,8,0,"C:":SN=SN+K10:T$=STR$(
SN):GOSUB 1810:T$=" DATA ":GOSUB 1810:T$
=STR$(MS):GOSUB 1810
1735 T$=STR$(WD):GOSUB 1800:T$=STR$(PEEK
(PCOLR0)):GOSUB 1800
1740 FOR WY=K0 TO YE:PM=PEEK(PMBASE+WY):
T$=STR$(PM):GOSUB 1800
1760 NEXT WY:T$="-1":GOSUB 1800:PUT #1,1
55:CLOSE #1:GOTO 570
1790 POSITION K19,K23:? "Ready Tape Reco
rder ";:RETURN
1800 PUT #1,44
1810 FOR WX=K1 TO LEN(T$):PUT #1,ASC(T$(
WX,WX)):NEXT WX:RETURN
1900 GOSUB 2500:GOSUB 1200:CSW=K1:GOSUB
1000:CSW=K0:SOUND 0,0,0,0
1905 GOSUB 1790:OPEN #1,4,0,"C:":FOR WX=
K0 TO K10:GET #1,A:NEXT WX
1910 GOSUB 2000:MS=PM:GOSUB 2400:GOSUB 2
000:WD=PM:GOSUB 2250:GOSUB 2000:POKE PCO
LR0,PM:GOSUB 950
1920 FOR WY=K0 TO K23:GOSUB 2000:IF P=45
 THEN POP :GOTO 1930
1930 P=PM:GOSUB 2100:NEXT WY
1990 CLOSE #1:GOTO 570
2000 PM=K0:FOR WX=K0 TO 4:GET #1,P:IF P=
44 THEN POP :GOTO 2090
2010 IF P=45 THEN POP :GOTO 2090
2020 PM=PM%K10+VAL(CHR$(P)):NEXT WX
2090 RETURN
2100 A=128:FOR WX=K0 TO K7:POSITION WX+K
5,WY:IF P<A THEN 2120
2110 ? I$;:P=P-A:GOTO 2130
2120 ? B$;
2130 A=A/K2:NEXT WX:A=PMBASE+WY:GOSUB 80
0:RETURN
2200 IF WD=K0 THEN WD=K1:GOTO 2230
2210 IF WD=K1 THEN WD=3:GOTO 2230
2220 WD=K0
2230 GOSUB 2250:GOTO 570
2250 POKE SIZEP0,WD:POSITION 24,21:? "W=
";WD:RETURN
2300 GOSUB 1200:IF MS=46 THEN MS=62:GOTO
 2330
2310 MS=46
2330 GOSUB 2400:FOR WY=K0 TO K23:PM=PEEK
(PMSAVE+WY):POKE PMBASE+WY,PM:POKE PMSAV
E+WY,K0:NEXT WY:GOTO 570
2400 POKE SDMCTL,MS:POSITION K19,21:? "M
=";MS;:PMSAVE=PMBASE
2410 WX=K512+34:IF MS=46 THEN 2430
2420 WX=1024+68
2430 PMBASE=TRAM%K256+WX:RETURN
2500 IF  NOT STRIG(K0) THEN 2500
2505 GOSUB 990:POSITION K19,K23:? P$;"Co
nfirm";:GOSUB 1300:LOCATE X+K5,Y,OC:H=12
8:CC=OC+H
2510 POSITION X+K5,Y:? CHR$(CC);:H=-H:CC
=CC+H:FOR W=K0 TO K23:NEXT W:P=STICK(K0)
:T=STRIG(K0)
2520 IF P=K15 AND T THEN 2510
2530 POSITION X+K5,Y:? CHR$(OC);:IF P<>K1
5 THEN POP :GOTO 570
2540 RETURN
```

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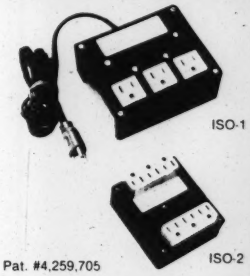

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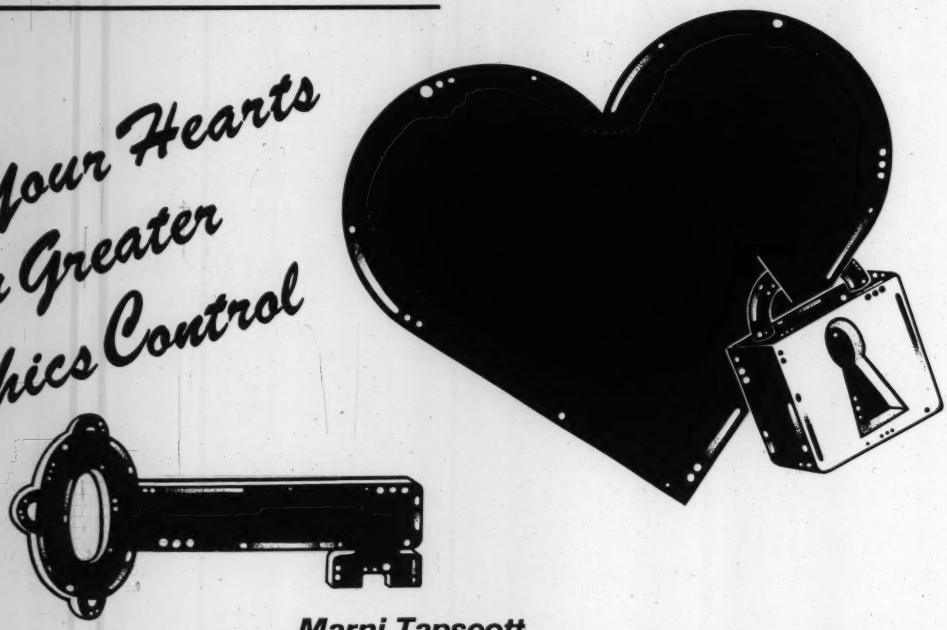

Marni Tapscott

The Atari has nine graphics modes. Modes 1 through 8 have a split screen, however, the split screen may be overridden by adding 16 to the mode number. Modes 1 and 2 are text modes with five colors. Characters in graphics mode 1 are twice as high and twice as wide as those in mode 0. Characters in mode 2 are twice as high and twice as wide as those in mode 0.

If you have ever tried to use the Atari graphics characters in mode 1 or 2 only to be dismayed by a screen full of hearts, or have had difficulty using all five colors available in those modes, read on. Solutions to some of the problems encountered in both areas will be discussed.

The character set in graphics mode 0 has 128 characters, upper and lower case letters, punctuation, numbers and Atari graphics characters. However, in graphics modes 1 and 2, only 64 characters are available at a time. There are three choices: numbers, upper case letters and punctuation including a blank space; the Atari graphics characters and lower case letters with no blank space; or your own character set.

Marni Tapscott, 297 Missouri St., San Francisco, CA 94107.

Listing 1.

```
100 REM FIGURE 1
110 GRAPHICS 1:POKE 756,226
120 ? "THIS IS WHAT HAPPENS WHEN 756 IS POKED WITH 226 IN GR. 1"
130 FOR WAIT=1 TO 2000:NEXT WAIT
140 SETCOLOR 0,0,0:REM SET COLOR REGISTER 0 TO SAME COLOR AS BACKGROUND
150 ? "THIS IS WHAT HAPPENS WHEN A COLOR REGISTER IS MADE SAME COLOR AS
    BACKGROUND."
160 FOR WAIT=1 TO 2000:NEXT WAIT
```

Creating Blank Spaces

Frequently, you will want to use blank spaces as well as the graphics characters. There are two ways of creating blank spaces. One is to give up one of the five colors available; simply make color register 0 the same color as the background and proceed to plot other characters using only color registers 1, 2 and 3. This is the straightforward solution. The short program in Listing 1 illustrates this alternative.

The second method of creating blank spaces requires more work; one character must be redefined. Novice programmers may be put off by the imposing sound of "redefining a character set," but I have discovered that it is not difficult and that it can open the door to greater graphics control and creativity.

It is important to point out that one or several characters can be redefined without redefining the whole character set. There are four basic steps.

First, we must allocate space in RAM for the character set and protect it from Basic. The top of RAM is the end of the section of memory accessible to the user. The physical top of RAM is stored in a location called RAMTOP. The area above the value stored in RAMTOP is Read Only Memory or ROM which contains permanent storage of programs and data that may never be changed. The operating system, for example, is stored here.

If we store a lower value in RAMTOP, we effectively reserve a section of RAM. The operating system will be fooled into thinking less RAM memory is available, and we can keep our new character set from being changed or erased by storing it in this area.

When I refer to "up" in memory, I am referring to those memory locations with higher numbers; "down" refers to memory locations with lower numbers. The diagram in Figure 1 may help.

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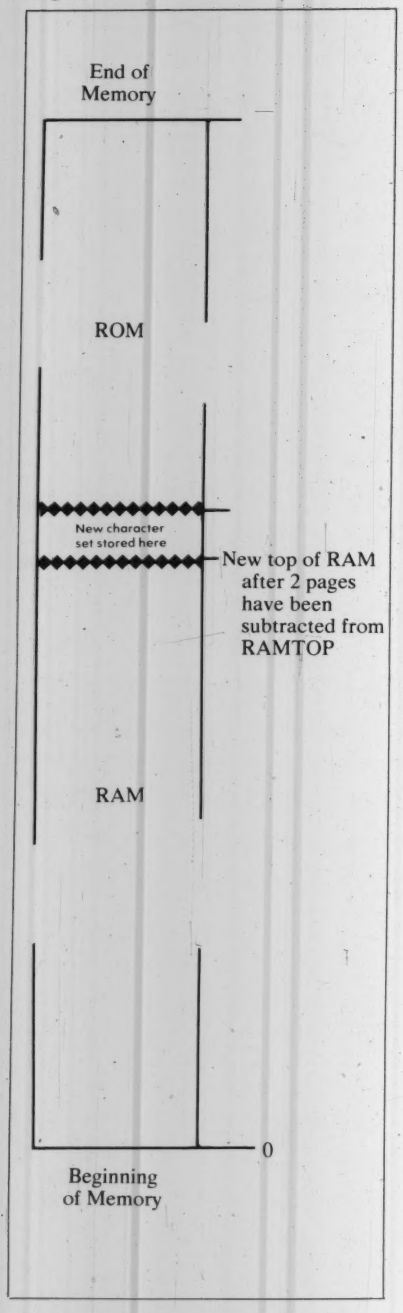
CIRCLE 167 ON READER SERVICE CARD

Figure 1.



Step one: Reserve memory for the new character set. Graphics modes 1 and 2 require 512 bytes or two pages for redefining a character set. In mode 0, we need 1024 bytes or four pages to redefine the 128 characters available. We PEEK at what is stored in RAMTOP (location 106), subtract the appropriate number of pages (each page=256 bytes) from that value and POKE it back into 106.

Step two: Move the present character set from ROM into the reserved section of memory. This is easily accomplished with a FOR/NEXT loop PEEKing the character set in the ROM location and POKEing it into the new location. The character set containing upper case letters, numbers and punctuation is located at 57344 in ROM and the alternate set containing the graphics characters is located at 57856 in ROM.

Step three: Inform the operating system where the new character set is located with a POKE 756, X where X equals the address of the new character set. Every time a graphics statement or reset is executed, the value in location 756 is reset to 224, the starting page address of the old character set in ROM, so it is best to include this POKE statement after any graphics mode statement.

Step four: Redefining the characters. The definition of a character uses 8 bytes in memory. Eight 0's must be poked into memory to take the place of an existing character. Since the heart is the first character in this set, I found it easiest to replace. The first 8 bytes or locations 0 through 7 in the section of memory we have set aside contains the heart. If we POKE 0's into these locations we will finally have a blank space. Incidentally, the reason the screen fills with hearts in modes 1 and 2 when you are trying to use the graphics characters is that the heart is stored in the same relative position as the blank space in the other character set.

These four steps eliminate the heart and define a blank space. Now we are ready to assign colors and positions to characters.

Assigning Color and Position

There are two methods; we may use either the POSITION and PRINT #6 statements or the COLOR and PLOT statements. Color manipulation is less obvious when using POSITION and PRINT #6 statements.

The ATASCII number that corresponds to both the character and the color desired must be obtained through some experimentation.

Since the other method employs charts already available in the Atari Basic Reference Manual, this method will be described in greater detail. For convenience the charts from pages 55 and 56 in the Atari Basic Manual have been reproduced here.

Figure 2.

Column 1				Column 2				Column 3				Column 4			
#	CHR	#	CHR	#	CHR	#	CHR	#	CHR	#	CHR	#	CHR	#	CHR
0	Space	16	0	32	@	48	P	64	♥	80	♣	96	♦	112	p
1	!	17	1	33	A	49	Q	65	┌	81	┌	97	a	113	q
2	"	18	2	34	B	50	R	66	┐	82	─	98	b	114	r
3	#	19	3	35	C	51	S	67	┘	83	┼	99	c	115	s
4	$	20	4	36	D	52	T	68	├	84	•	100	d	116	t
5	%	21	5	37	E	53	U	69	┤	85	▔	101	e	117	u
6	&	22	6	38	F	54	V	70	╱	86	▕	102	f	118	v
7	'	23	7	39	G	55	W	71	╲	87	┬	103	g	119	w
8	(	24	8	40	H	56	X	72	◢	88	┴	104	h	120	x
9	)	25	9	41	I	57	Y	73	▘	89	▏	105	i	121	y
10	*	26	:	42	J	58	Z	74	◣	90	└	106	j	122	z
11	+	27	;	43	K	59	[	75	▖	91	┼	107	k	123	♠
12	,	28	<	44	L	60	\	76	▌	92	↑	108	l	124	|
13	-	29	=	45	M	61	]	77	▄	93	↓	109	m	125	↖
14	.	30	>	46	N	62	^	78	▙	94	←	110	n	126	◀
15	/	31	?	47	O	63	_	79	▟	95	→	111	o	127	▶

Figure 3.

Table 9.7—CHARACTER/COLOR ASSIGNMENT					
		Conversion 1	Conversion 2	Conversion 3	Conversion 4
MODE 0	SETCOLOR 2	# • 32	# • 32	# - 32	NONE
		POKE 756,224		POKE 756,226	
MODE 1 OR MODE 2	SETCOLOR 0	-32	# • 32	# - 32	# - 32
	SETCOLOR 1	NONE	# • 64	# - 64	NONE
	SETCOLOR 2	# • 160	# • 160	# • 96	# • 96
	SETCOLOR 3	# • 128	# • 192	# • 64	# • 128

Charts provided courtesy Atari Inc. ©1980.

First, the four colors desired are established in the color registers using SETCOLOR statements. SETCOLOR 0,1,8 establishes gold in register 0. Next, find the character you wish to use in the chart in Figure 2. Make note of both the number next to the character and the column in which it is located. Looking at the second chart in Figure 3, add or subtract the number listed here according to the color desired. The "columns" on the first chart correspond to the "conversions" on the second chart.

For example, I want a gold up arrow to appear at Row 5, Column 5. The up arrow is 92 in Column 3 in Figure 2. Looking at Figure 3, we subtract 32 from 92 since gold is in color register 0. The statement below accomplishes our goal:

COLOR 60:PLOT 5,5

Listing 2 is a short program which illustrates both the redefinition of the heart character to a zero and the use of SETCOLOR, COLOR and PLOT statements for full use of all five colors. (The fifth color is the background color.) One word of caution regarding running the program: always press the system reset button before re-running because the system continues to subtract pages in memory until it interferes with the display memory.

Listing 2.

```
90 REM FIGURE 5
100 REM CHARACTER REDEFINITION
110 REM STEP ONE: SET ASIDE MEMORY FOR CHARACTER SET
120 POKE 106,PEEK(106)-2
130 GRAPHICS 2+16:REM GR.STMT.HERE PREVENTS OVERLAP OF DISPLAY LIST
    & CHARACTER SET
140 REM STEP TWO MOVE: CHARACTER SET INTO NEW LOCATION
150 A=PEEK(106)*256
160 FOR B=0 TO 511
170 POKE A+B,PEEK(57856+B)
180 NEXT B
190 REM STEP THREE: POKE NEW ADDRESS OF CHARACTER SET
200 POKE 756,PEEK(106)
210 REM STEP FOUR: CHANGE HEART TO BLANK SPACE
220 FOR C=0 TO 7
230 POKE A+C,0
240 NEXT C
250 REM
310 REM SET UP COLOR REGISTERS
330 SETCOLOR 0,13,8:REM GREEN
340 SETCOLOR 1,4,8:REM PINK
350 SETCOLOR 2,10,8:REM TURQUOISE
360 SETCOLOR 3,2,8:REM GOLD
365 SETCOLOR 4,12,4:REM BACKGROUND COLOR TO GREEN
370 REM
390 COLOR 60:PLOT 5,5:REM GREEN ARROW
400 COLOR 28:PLOT 6,5:REM PINK ARROW
410 COLOR 188:PLOT 7,5:REM TURQUOISE ARROW
420 COLOR 156:PLOT 8,5:REM GOLD ARROW
450 GOTO 450:REM KEEPS DISPLAY ON SCREEN
```

Suggestions for further experimentation are:

- Redefine more characters for greater graphics variety.
- Combine two or four or more characters for a larger, more complex shape.
- Animate shapes through color rotation.
- Animate shapes through redefinition of a figure (animal, person) in several positions and rotation of positions. □

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Figure 1.

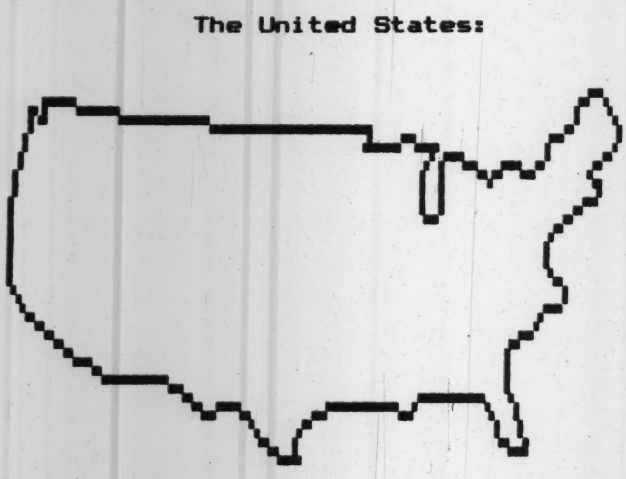

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Figure 1.

The United States:

LOCATION	VALUE	LOCATION	VALUE	LOCATION	VALUE	LOCATION	VALUE
60	160	61	176	66	156	67	186
68	131	69	131	70	131	71	140
72	140	73	140	74	140	75	164
76	176	77	176	78	176	79	176
80	176	81	176	82	176	83	176
84	176	123	150	124	129	126	137
127	144	129	168	130	129	149	131
150	131	151	131	152	131	153	131
154	131	155	131	156	131	157	131
158	131	159	131	160	131	161	131
162	131	163	131	164	131	165	187
166	176	167	176	168	176	169	140
170	164	171	176	172	176	184	152
185	140	186	131	191	154	192	160
193	133	235	152	236	129	237	150
238	131	239	137	240	140	241	176
242	160	243	152	244	140	245	164
246	176	247	140	248	129	252	160
253	140	254	131	256	154	299	149
301	149	306	129	316	176	317	155
320	149	363	137	364	140	365	129
377	176	378	140	379	131	384	149
440	150	448	149	504	137	505	176
512	130	513	164	568	176	569	176
570	133	578	131	579	140	580	176
629	160	630	176	631	134	645	131
646	140	647	176	648	176	692	150
693	129	713	131	714	140	715	140
716	140	717	140	718	140	719	140
720	140	721	176	722	144	756	149
786	130	787	137	788	164	789	176
790	140	791	140	792	164	793	144
800	176	801	152	802	140	803	140
804	140	805	140	806	140	807	140
808	140	809	176	810	152	811	131
812	131	813	131	814	131	815	131
816	131	817	131	818	164	820	130
821	148	857	130	858	164	859	144
862	152	863	131	883	165	884	144
885	138	886	144	923	130	924	137
925	140	926	141	948	130	949	131
950	129						

Figure 2.

Android:

LOCATION	VALUE	LOCATION	VALUE	LOCATION	VALUE	LOCATION	VALUE
480	176	481	191	482	191	483	191
484	176	544	190	545	189	546	143
547	190	548	189	608	184	609	174
610	191	611	157	612	180	671	130
672	173	673	186	674	191	675	181
676	158	677	129	737	170	739	149
800	136	801	142	803	141	804	132

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Listing for Graphics Drawing Board.

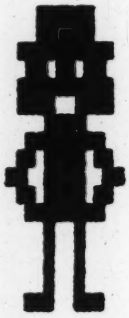
```
10 I=0:LN=128:L=480:DIM LO(1023):C=1
20 CLS
22 PRINT"    HIT 'P' TO PRINT SCREEN DATA
   HIT 'C' TO CLEAR LOCATION"
25 SET(0,0):SET(127,0):SET(127,47):SET(0,47)
30 POKE 15360+L,95
35 '-----------SCAN KEYBOARD-----------
40 IF PEEK(14340)=1 THEN 900
50 V=PEEK(14400):V=V/8
60 ON V GOTO 500,600
70 V=V/4
80 ON V GOTO 700,800
85 IF PEEK(14337)=8 THEN POKE15360+L,95:LO(L)=0
87 LN=PEEK(15360+L):IF LN<128 THEN LN=128
90 ON VAL(INKEY$)GOTO 100,400,450,100,300,350,100,200,250
100 GOTO 40
195 '------------MAKE GRAPHIC PIXELS LIGHT UP--------------
200 IF LN+1>191 THEN40 ELSE LN=LN+1:POKE 15360+L,LN:GOTO 40
250 IF LN+2>191 THEN40 ELSE LN=LN+2:POKE 15360+L,LN:GOTO 40
300 IF LN+4>191 THEN40 ELSE LN=LN+4:POKE 15360+L,LN:GOTO 40
350 IF LN+8>191 THEN40 ELSE LN=LN+8:POKE 15360+L,LN:GOTO 40
400 IF LN+16>191 THEN40 ELSE LN=LN+16:POKE 15360+L,LN:GOTO 40
450 IF LN+32>191 THEN40 ELSE LN=LN+32:POKE 15360+L,LN:GOTO 40
495 '-----------MOVE CURSOR----------
500 IFL-64<1ORL-64=63THEN85
505 IFPEEK(15360+L)>127THENLO(L)=LN
510 IFPEEK(15360+L)=95THENPOKE15360+L,32
520 L=L-64:IFPEEK(15360+L)<128THENPOKE15360+L,95:FORI=1TO20:NEXTI
530 GOTO85
600 IFL+64>1022ORL+64=960THEN85
605 IFPEEK(15360+L)>127THENLO(L)=LN
610 IFPEEK(15360+L)=95THENPOKE15360+L,32
620 L=L+64:IFPEEK(15360+L)<128THENPOKE15360+L,95:FORI=1TO20:NEXTI
630 GOTO85
700 IFL-1<1ORL-1=63ORL-1=960THEN85
705 IFPEEK(15360+L)>127THENLO(L)=LN
710 IFPEEK(15360+L)=95THENPOKE15360+L,32
720 L=L-1:IFPEEK(15360+L)<128THENPOKE15360+L,95
730 GOTO85
800 IFL+1>1022ORL+1=63ORL+1=960THEN85
805 IFPEEK(15360+L)>127THENLO(L)=LN
810 IFPEEK(15360+L)=95THENPOKE15360+L,32
820 L=L+1:IFPEEK(15360+L)<128THENPOKE15360+L,95
830 GOTO85
895 '-----------DISPLAY GRAPHIC CODES FOR PICTURE------------
900 IFPEEK(15360+L)<128THEN905ELSELO(L)=LN
905 CLS:FORI=1TO4:PRINT"LOCATION-VALUE",:NEXTI
910 FORI=0TO1023:IFLO(I)=0THENGOTO930
920 PRINTTAB(P+2)I;TAB(P+9)LO(I);
925 P=P+16
927 C=C+1:IFC=5THENPRINT:C=1:P=0
930 NEXTI
940 PRINT:PRINT:INPUT"DO YOU WANT TO OUTPUT
    THE DATA TO A PRINTER(Y/N)";A$
950 IFA$="N"THEN1030
960 '-----------OUTPUT TO PRINTER----------
965 C=1:P=0
970 FORI=1TO4:LPRINT"LOCATION-VALUE",:NEXTI
975 LPRINT
980 FORI=0TO1023:IFLO(I)=0THEN1020
990 LPRINTTAB(P+2)I;TAB(P+9)LO(I);
1000 P=P+16
1010 C=C+1:IFC=5THENLPRINT:C=1:P=0
1020 NEXTI
1025 LPRINT
1030 INPUT"DO YOU WANT TO ADD TO THE PICTURE";B$
1040 IF B$="N" THEN PRINT"GOOD-BYE":END
1050 '-----------DRAW PICTURE ON SCREEN--------------
1060 CLS
1065 PRINT" HIT 'P' TO PRINT SCREEN DATA
     HIT 'C' TO CLEAR LOCATION"
1067 SET(0,0):SET(127,0):SET(127,47):SET(0,47)
1070 FORI=0TO1023:IFLO(I)=0THEN1090
1080 POKE15360+I,LO(I)
1090 NEXTI                                1097 C=1:P=0
1095 IF LO(L)<128THENPOKE15360+L,95       1100 GOTO 40
```

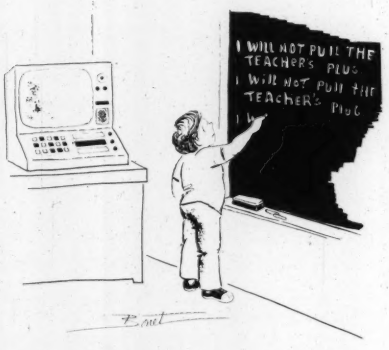
Drawingboard, continued...

The picture of an android (Figure 2) was also rapidly created in this manner.

To correct a mistake in any part of the design, just move the cursor to the block in which the mistake is located and hit the "C" key to clear that character block of its contents; then, use the numbers to change the contents of the block as needed.

When the design is finished, hit the "P" key to print out the location of the character blocks composing the picture (same as "PRINT AT" locations) and their corresponding values (ASCII graphics codes). The tedious graphics-ASCII conversion is completed without human error. □





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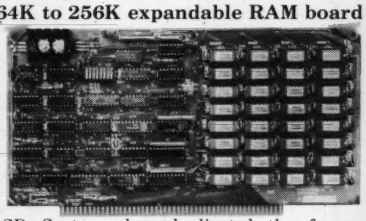

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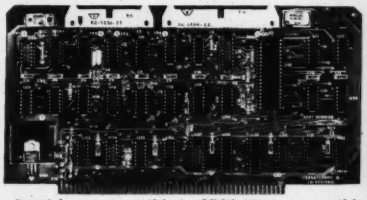

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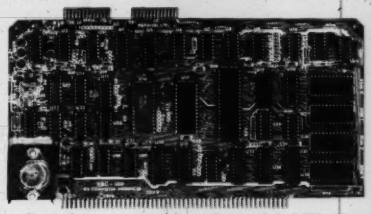

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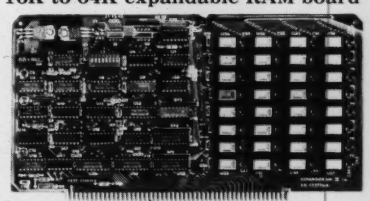

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-All boards are assembled and tested-

MPC-4

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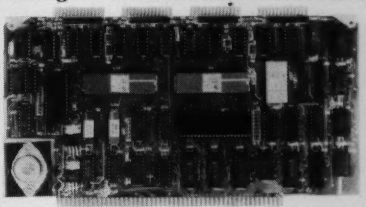

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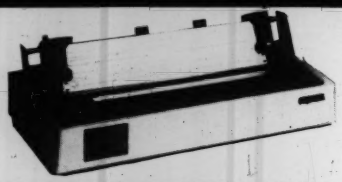

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PRA-27081A *Apple card* **$39.95**
PRA-27082A *Apple cable* **$19.95**
PRA-27087A *TRS-80 cable* **$24.95**
PRA-43080 *Extra ribbons pkg. of 2* ... **$9.95**

INEXPENSIVE PRINTERS - Epson

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PRM-27070 *List $459* **$399.95**

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PRM-27080 *List $645* **$469.95**

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PRA-27081 *Apple card* **$74.95**
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IOI-2052A *Serial A & T* **$99.95**
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outpost: atari

David & Sandy Small

A Note from the Author

Once upon a time, a very imaginative company looked at the home computer market. It found the graphics available on many of the machines to be limited. So the company designed a powerful machine with particularly good graphics capabilities. And it sent this machine out onto the market.

But no one understood how it worked. It was not a mere clone of earlier machines; it incorporated some revolutionary ideas. So few were bought. The company began to see that until the inner workings were understood, this machine would not sell very well.

On the other hand, they felt, when the power and flexibility of the machine became known, it would have no competition in its field. But there was absolutely no tutorial material available to unwrap the powerful goodies in the Atari. And without a tutorial, discerning the concepts behind the computer was very, very difficult.

Compounding the problem was the fact that the only available documentation was reference manuals, which were never intended to be teaching guides. Once the basic concepts were understood, the machine wasn't difficult to use, but mastering those concepts was nearly impossible.

A few magazines were running scattered tutorials in bits and pieces. For the most part, authors were in the same boat as the general public, but they shared what knowledge they had with the computing public. Gradually, the available information began to spread.

In June of 1981, *Creative Computing* began a tutorial series on the Atari in this column. The tutorial series has covered the abilities of the Atari from the point of view of the Basic programmer, and has assumed little knowledge on the reader's part of esoteric computer buzzwords. (What was needed was explained.) The series has been well-received by readers, and will be published shortly as part of *The Creative Atari* from Creative Computing Press. It remains the only beginner's level tutorial on the Atari.

Creative does deserve kudos for publishing the series and really trying to help its Atari readers.

Even though the number of Atari owners in the readership is much smaller than, for example, TRS-80 owners, *Creative* has devoted a good deal of space to the series. If you're in the letter writing mood, you might drop George Blank or Betsy Staples a line and thank them for their efforts and for taking the risk.

In future columns we plan to include more product reviews and the sorts of things one would expect in a column. Now that we have defined the basic concepts, we can discuss the Atari in other than beginning-level language, and add to the knowledge available. We will also try to keep you up to date on the latest from the rumour mill and from Atari.

Needless to say, as authors we leave many questions untouched—our articles sometimes raise more questions than they answer. Such is the way of the Atari: there is always another feature to cover. And we get many letters asking questions.

Sandy and I have been swamped with letters asking questions about the Atari. We try to answer them all, but we do tend to answer those with an S.A.S.E. enclosed the fastest (let's say within two months). If you do send a letter, please don't expect a typed reply, and try to keep the questions short so we can answer them fairly quickly. Also, if the answer is in a previous column, and long, we'll probably just refer you to that column; you can order back copies of magazines from *Creative* and most computer stores stock a few back issues.

In this column, we'll attempt to cover a variety of short subjects. None of them is broad enough to write a column about, yet all deserve an answer.

Questions & Answers

Q. PEEK(741)+256*PEEK(742) (from July '81) is not a good way to find the display list. PEEK(560) is. Why didn't you?

A: Knowledge about the Atari is a rapidly unfolding thing. We pass on what we know when we know it. And remember, we write columns about four months before you read them. Since we are experimenting with the Atari all the time, and learning more, sometimes we discover a better way of doing things about which we have already written. No matter; we try to give the best of what we know at the time.

Q: In the DLI article (December 1981) you don't use memory page 6. Why? If you did, you could fix the location of the program and avoid the relocation code.

A: First, we left the page alone so the user could use it along with the DLI routine. Remember, the DLI routine will coexist and coexecute along with many assembly routines as it is an interrupt handler. Hence, it is potentially more useful located outside of page 6.

Second, it gives us a chance to explain all about string handling and the general principles behind regarding a string as just a collection of bytes in memory, useful in other ways besides merely holding characters. These are tutorials, remember, and often the stated goal is far less important than the getting there. The principles behind the demonstration will be far more useful, in many ways, than will be the demontration.

Q: In the July article you show a mixed mode display, which I can't produce. Could you send me the code for this? (Multiply this by 80 letters or so.)

We omitted the code because I was addressing the principle of stacking display blocks, and the code is somewhat confusing. It tends to raise more questions that it answers, but I have included it here for the curious. See Listing 1.

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CIRCLE 196 ON READER SERVICE CARD

Atari, continued...

Listing 1.

```
10 REM GRAPH PROGRAM
20 REM LAYOUT:
30 REM
40 REM 1 LINE GR.2      20 BYTES 16
50 REM 1 LINE GR.2      40       32
60 REM 1 LINE GR.0      80       40
70 REM 120 LINE GR.8 80+(4800)   160
80 REM 1 LINE GR.0      +40      168
90 REM 1 LINE GR.0      +40      176
100 REM 1 LINE GR.0     +40      184
110 REM 1 LINE GR.0     +40      192
200 REM SET MODE
210 GRAPHICS 8+16:REM FAKE LAST FOUR
220 REM DISPLAY LIST
230 ST=PEEK(560)+256*PEEK(561)
240 REM ST+0,ST+1,ST+2=112..LEAVE BE
242 REM ST+3=79. CHANGE TO 7+64.
243 POKE ST+3,7+64
245 REM ST+4,+5=DATA. LEAVE BE.
246 REM ST+6,ST+7=15. MOD TO 7,2.
247 REM (MODE 2, THEN MODE 0).
248 POKE ST+6,7
249 POKE ST+7,2
250 REM DM + 0 - DM + 29 = MODE 2 L1
255 GOSUB 1000
260 DIM A$(60)
261 SETCOLOR 4,8,2
270 A$=" MODE 2 BIG TITLE    "
280 REM 12345678901234567890
290 REM TRANSLATE A$ TO INTERNAL CSET
300 GOSUB 500
330 REM FIND DISPLAY MEMORY
340 DM=PEEK(ST+4)+256*PEEK(ST+5)
410 REM POKE INTO MEMORY
420 FOR T=1 TO 20
430 POKE DM+(T-1),ASC(A$(T,T))
440 NEXT T
450 A$=" MODE 2 SECOND LINE "
460 REM 12345678901234567890
470 REM TRANSLATE A$ TO INTERNAL
    CSET
480 GOSUB 500
485 REM POKE INTO MEMORY
490 FOR T=1 TO 20
493 POKE DM+20+(T-1),ASC(A$(T,T))
496 NEXT T
497 GOTO 600
500 REM SUBROUTINE TO XLATE ASC TO
510 REM INTERNAL CSET
520 FOR Z=1 TO LEN(A$)
530 IF A$(Z,Z)=" " THEN A$(Z,Z)=
    CHR$(0)
540 IF ASC(A$(Z,Z))<>0 THEN A$
    (Z,Z)=CHR$(ASC(A$(Z,Z))-32)
550 NEXT Z
560 RETURN
600 REM DO MODE 0 LINE NEXT.
    40 BYTES
610 A$="  A TEXT MODE 0 SUBTITLE"
620 REM XLATE
630 GOSUB 500
640 REM POKE INTO MEMORY
650 FOR T=1 TO LEN(A$)
660 POKE DM+40+(T-1),ASC(A$(T,T))
670 NEXT T
675 REM PLOT A SAMPLE GRAPH
676 SETCOLOR 2,8,0
680 XMIN=2
690 YMIN=5
700 XMAX=319
710 YMAX=159
720 COLOR 1
725 PLOT 1,70:DRAWTO 319,70:PLOT 1,70
726 XSAV=1:YSAV=70
730 FOR X=5 TO 315 STEP 5
740 Y=INT(RND(0)*70)+40
750 DRAWTO X,Y
752 PLOT XSAV+1,YSAV:DRAWTO X+1,Y
753 PLOT XSAV+2,YSAV:DRAWTO X+2,Y
755 XSAV=X:YSAV=Y
760 NEXT X
770 REM PUT IN 4 TEXT LINES AT BASE/
780 REM AFTER 160 (GR.8) INSTRUCTIONS
790 GOTO 790
1000 FOR Y=ST+150 TO ST+210
1010 IF PEEK(Y)=65 THEN 1100
1020 NEXT Y
1030 PRINT "PLATO OFF."
1040 STOP
1100 B1=PEEK(Y+1)
1110 B2=PEEK(Y+2)
1120 POKE ST+162,B2
1130 POKE ST+161,B1
1140 POKE ST+160,65
1150 RETURN
```

Basically we are modifying a graphics 8 display list to:

GR.2
GR.2
GR.0
Gr.8 x lots

We are not duplicating the July display exactly, but you can with the principles in the code.

We use two GR.2 lines to make the memory requirements come out to 40 bytes, to keep "in sync" with graphics 8. We then put data into the first 120 bytes of DM for character output.

Character data is translated from ATASCII to INTERNAL format for display; they are not the same. A machine language routine here would be quite nice; there is probably one in the operating system that could be used. The INTERNAL codes are then POKEd into memory.

Because we now generate 16+16+8+189 scan lines, instead of 192, we have a total of 229 generated lines. This will probably cause your TV to "roll." So we chop out the lower 40 graphics 8 instructions by moving the JVB instruction up. I copy the data bytes first, then the JVB byte, to prevent the JVB taking off into random memory.

Or so we thought. (And so we told you.) JVB is the jump and wait for vertical blank; it makes the display list into a GOTO loop, so we said. Except that just by accident we found out that where it jumps to doesn't matter. That's right: the data bytes following the JVB are irrelevant. Why? Because at the start of every screen refresh, the operating system copies the display list location shadows (560, 561) into Antic and re-sets him to the start of the DL. So all is well even if Antic, at the end of the DL, jumps off to kingdom come.

Except: during disk accesses, where apparently the Vblank routine copy is nulled. Then the screen will go wild. (See what I mean about "rapidly changing knowledge"?)

Along these lines, a fun display is to set up two display lists and two display memories, and have Antic execute them alternately. (Use a DLI in the first 112 instruction to swap display memories.) You'll get two displays superimposed on each other. For example, we had a graphics 0 display of Basic code imposed on the graphics 8 display it produces. Nice, and nifty for an editor or such. However, it does tend to flicker.

Q: Speaking of flickers, your DLI routine has an annoying flicker in midscreen—a border between two colors that jumps back and forth. Why?

A: You're right. Next question?

Seriously, the reason for this is that the 6502 just doesn't have enough time to copy all the data into the CTIA color registers before the TV scan line begins. In fact, it can't even start until midway through the last scan line of the display block with the interrupt flagged. The TV refresh process outruns this rather generalized routine. You'll have to learn assembly language to deal with this properly; use WSYNC, then rapidly store up to three colors after the WSYNC using STX, STY, and STA. You'll still be offscreen. For those of you I've lost, the timing of a DLI routine is a very touchy thing; if you don't know machine language and how the Atari relates to the TV, forget it.

This routine will also crash in graphics 8 as it will not complete between interrupts if you have interrupts on two consecutive scan lines. If you want that, learn assembly language, then write your own driver.

On Memory Boards

Q: My Atari dies after being on for a while. Or, my Atari freaks out unexpectedly. Or, my Basic programs scrozzle themselves. Or....

A: 1. If you squeeze the last few bytes of available memory, Basic seems to screw

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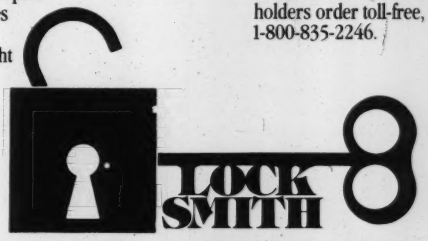

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• **William H. Gates**. President, Microsoft, Bellevue, Washington. Mr. Gates—the father of microcomputer software—provided an inside look at "Things to Come in Personal Computer Software."

• **A.C. (Mike) Markkula**. President, Apple Computer Inc., Cupertino, California. Mr. Markkula examined forthcoming breakthroughs in personal computer technology in his talk "Making Computers Easier to Use: Trends in the User Interface."

• **Peter Rosenthal**. Marketing Manager, Atari Computer Division, Sunnyvale, California. Mr. Rosenthal offered a vision of "The Home Computer of the Future" and its impact on our homes.

• **Jon Shirley**. Vice President, Radio Shack Computer Merchandising, Fort Worth, Texas. Mr. Shirley explored the business applications of future computers with "Personal Computers in the Office of the Future."

• **Nigel Searle**. Vice President, Sinclair Research Ltd., Cambridge, England. Mr. Searle considered the impact of personal computers on consumers in his talk "The Consumer Marketplace for Future Personal Computers."

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up. Something in the upper memory management routines fails during tight squeezes, and there isn't much you can do about it. Sorry.

2. The Atari memory boards may be giving you trouble. Here's Small's Memory Board Fix (which works amazingly often on bizarre Atari problems):

The Atari memory boards get hot, really hot, in their enclosed metal cans in the enclosed metal cage. This heat can mess things up, particularly in the connectors. The metal is necessary to avoid spraying radio frequency interference all over, but it does cause problems. So every month or so we pull all the boards out of the Atari and re-seat them. This re-establishes the socket connection. Cleaning the ends of the connector (a pencil eraser works wonders) and coating them with Lubriplate, then re-seating them is also a good idea—helps prevent corrosion.

If this fixes it, fine. If not, go the drastic route (as we had to on one very touchy 800):

1. Remove the lid. Bypass the interlock with a taped in Q-Tip.

2. Remove the memory board lids (pull the two Phillips head screws). Re-install the boards.

This will really help to keep things cool. Of course, you may not be able to watch TV nearby (nor will your neighbors) but it *will* prevent overheating.

Now that you have the lid open, some of you are doubtless going to get the clever idea of copying ROM cartridges onto disk. After all, you can boot up, then plug them in with DOS running. Then, a simple binary save, right?

Wrong.

Atari has some nasty, nasty surprises awaiting you if you try this. First, plugging the cartridges in sends a nice hefty spike into the memory lines, straight into sensitive Antic, CTIA, and the 6502B. Do you really want your Atari in the repair shop? All it takes to destroy these chips is a little static electricity in the wrong place, and your body is probably full of it in the winter.

Second, the Atari people have some special checks to prevent this. For example, disk I/O doesn't work the way you might expect from cartridges. Ever had your directory mysteriously disappear? This should be food for thought.

On Piracy

Speaking of piracy in general. I have found copies of my software (what goes into these articles) floating around all over the place. This is really embarassing when the disk that was pirated is a development disk and you've saved all sorts of junk on it.

But second, when you think about it, the prices you pay for software nowadays in many cases are pretty low anyway (when was the last time you could go on a date for $20), so why not give the author his royalties, and get the documentation as well?

I wish that people didn't consider protection schemes a Scott Adams adventure #30 to be broken. If you think about it, the hours you spend breaking the scheme are equal in dollars to what you would pay for the software in many cases. (And if you're thinking about selling copies, don't; all the software companies I've talked to are *currently* prosecuting people caught doing this.)

Q: I have 32K. Should I get 48K?

A: Maybe. If you use no cartridges, the Atari can use up to 48K RAM. If you use one cartridge, you are reduced to 40K available; if you use two, 32K. Eventually, as more RAM-only programs become available, 48K will be more and more handy. For example, Microsoft Basic, which we are currently testing, requires 48K but has no cartridges (disk based). We're in a transition period, in other words, and it may be to your advantage to wait a bit; hardware prices are dropping quickly, as usual.

On Disks

Q: During a disk access, my disk stops for a while for no reason and then restarts. Why?

A: A bug in the O.S. program. No, the disk isn't stopping to cool off (like an 820 printer) or anything. This is fixed in the new revision cartridges, which are slowly becoming available.

Q: What are DOS 2.5, 2.7, 2.8, 2S, 2.0S, 2.0D?

A: DOS 2.0S is the final, "cast in concrete" version of DOS 2. The others are developmental versions. They are pre-release copies. There are lots of 2S disks lying around; these have a bug in the interrupt subsystem, so best get rid of them. Also, if you boot up under 2S, you can't "DOS" to a 2.0 version of DOS. They're incompatible. So your best bet is to change your disks over to 2.0S and use it.

DOS 2.0D is for the double density 815 drive, which has been cancelled, delayed, sent back, or whatever (depending on who you talk to).

Q: What is a "fast formatted disk?"

A: Inside the 810 disk drive there is a microprocessor. When the Atari wants a given disk sector (128 bytes), it asks that microprocessor for it. The micro then spins the disk and moves the head to get that sector. If you have a disk with a more efficient layout, you can go between sectors (without a complete spin between them, for instance). A "fast formatted disk" has this improved layout, and, thus, when you access it, disk I/O is around 20% faster.

Disks that you format with your 810 will not have this improved layout, because it lays them out the old, slow way. A new ROM, called the "C" ROM, can be installed into your disk drive to make it format disks the fast way.

Who knows when it will be available? The rumour mill says that 1) all disk drives going to Europe have it; 2) all disks to the East Coast have it; 3) all disks shipped after September 1981 will have it, etc. Probably by the time this is printed some policy will have been established.

For those of you who can't wait, the Chicago area user's group has constructed their own version of the format ROM, which requires a few wiring changes to the disk and programming a new EPROM (not your beginner-level stuff). The Chicago ROM is 10% faster than the Atari ROM, which is definitely interesting. The ROMs work quite well; I've seen them tested. However, since the Chicago folks developed them I'll let them document it and take the credit. Incidentally, modifying a drive this way (of course) violates the warranties.

"Waddaya wanna do now—Trolls and Wizards, Fun with Math, Space Invader, Amalgamated Industries' profit and loss statement for 4th quarter FY '80...?"

On GTIA

Q: What's the GTIA chip and how do I get one?

A: The CTIA chip actually generates color for your TV. A new chip, GTIA, replaces CTIA and allows graphics modes 9, 10, and 11 out of Basic. (The operating system was written with GTIA in mind, and so was Basic, by the way.) It is an upgrade to the CTIA chip. The rumour mill again says it is available everywhere except where the rumour originates. We have one as the result of extreme kindness on the part of Atari, and are testing it. The added modes are:

Graphics 9: Allows 16 intensities (select by COLOR #) of pixels to be displayed in the background color. Great for grey-scale shading.

Graphics 10: Allows eight different kinds of pixels to be displayed in any of the standard colors. Uses the four P-M registers and four playfield registers to set colors.

Graphics 11: Allows 16 different colors for pixels, all in the same intensity.

The pixel size is four bits long, and one scan line high. This is 80 x 192 resolution, an interesting twist on the general rule that vertical resolution is less than horizontal.

There will be a more complete article on the GTIA chip when it is more widely available. (The problem is, most people at Atari don't have them either, and are trying just as hard to get one. Who do you think will get priority?)

On Languages

Q: Forth?

A: Forth is a dynamite programming language available for the Atari. Its speed is somewhere between Basic and assembly language, but much closer to assembly language. Best of all, it's a reasonably high level language (very stack oriented, as a matter of fact). I'm trying to learn it now. Versions are available from many sources. Atari lists Forth in their APEX exchange, but will not release it yet. Beware of other versions which may use undocumented entry points in the operating system, and which will quit working when the new cartridges are generally available.

There has been a lot of good software written in Forth. I have a synthesizer program, lent to me by Ed Rotberg of Atari, which plays the best music I ever heard from an Atari (and has different instrument sounds, too; drums, guitar, hand clapping, etc.). The Atari demo with the "Disco Dirge" is written in Forth to give you an idea of its execution speed and flexibility.

Q: Microsoft Basic.

A: You will be hearing a great deal about this from us. We are currently working with Microsoft Basic and it is a fantastic product, indeed. It is much faster than the Atari 8K cartridge Basic and has many, many more functions. It really turns the Atari into a serious business computer, for example. Look at the description of Microsoft Basic in any Apple, TRS-80 or PET book and you will get an idea what is available. Add to that many special Atari functions, and soon you will be writing only in Microsoft. (Look for a complete review shortly). □

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Will Fastie

The other night when I came home I carried the garbage cans around to the back of the house, a normal chore for a Tuesday evening. I was shocked to discover my IBM Personal Computer system table sitting outside instead of in its assigned place in the basement. Those of you who have been following my column to this point know about my table. (Those of you who don't—subscription information can be found in the front of this magazine, and back issues are available. Get with it!) Now there is a rule in my house about clutter—it ain't permitted. My table, this table of vast sentimental value, this foundation of future computing, had been evicted!

My wife and I are reasonable people. Naturally, we had a quiet, intelligent discussion to try to decide where the table should go. I could not accept her first suggestion. Upon determination that her second suggestion was anatomically impossible, I reconsidered the first proposal and found it worthy. See Photo 1.

So Where's Will's Computer?

That's what I'd like to know.

It's hard to be buying a computer just as it is introduced. My order has been in for thirty days and I expect another thirty to pass before I get it. My business associates, reciting folk wisdom about IBM delivery, argued that the IBM Personal Computer would be no different. IBM's Data Processing Division (DPD) said "no, we understand the nature of this business and the computers will flow like water." I decided (wanted) to believe them. I ignored the reality of a new computer product introduction, with its inevitable longer-than-average lead time resulting from production startup. I should have known better.

That's the story at deadline. Now that you're reading this magazine, I should have my machine and the general situation should have smoothed out somewhat. It is generally believed, although IBM will not comment on production volumes, that the Boca Raton facility has or will have the capacity to manufacture 100,000 units per year. I would certainly think that such a volume would handle the demand for the immediate future. The only question is how fast IBM can get to a production level that will satisfy that market demand.

I wondered if the situation was any different for Computerland, without question the largest buyer for retail distribution. I didn't get any facts, but rumor was that they had a backlog of orders for 2,000 units. It seems that some systems are trickling to the stores, but the local dealers I've spoken with won't commit to a delivery schedule as yet.

Besides the fact that I don't have my computer to play with yet, there is the question of what I will tell you about in this computerless column. I've decided to talk about what you need to do when you bring your system to its home, be it your home or business.

Where Should You Put It?

There are several things that will affect your decision about the location of the system.

In the office, convenience will play a dominant role for obvious reasons. Ease of access and user comfort are important for the office because it is likely that people will regularly spend long stretches of time with the system. There should be plenty of room for the system, including adequate space for the printer paper. There should be ample workspace next to the system for the user. The manuals should be kept close at hand, for easy and quick reference.

In the home, the location of the television will probably dictate a location for the system, especially if it is wired for cable TV. This is less of an inconvenience with the IBM computer because the keyboard is connected with a coiled cable and can be placed as much as six feet from the system unit. It is also probable that a home system will not be used quite as intensively as its sister in the office, so user fatigue is less a problem.

Environment is another factor, although

Photo 1. The Author's System.

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not as important as it was only ten years ago when virtually every computer had to be refrigerated. For computers like the IBM Personal, it is only necessary to avoid extremes of temperature and humidity. If you are reasonably comfortable, the computer probably is too. You should also try to keep the system away from dirty or dusty places. Relatively small amounts of dirt and grit can permanently damage diskettes. That same dirt affects the operation of the diskette unit as well.

I am not aware of the existence of a cover for the IBM system. This is a regrettable oversight if none is available. The simple act of covering the system when it is not in use can extend the life of the system and prevent damage which could result in large repair bills.

Finally, the system will have to be placed near an electrical outlet, as described in the next section.

Plugging It In

You should plan the location of your computer before you get it. This will give you some time to arrange to have the proper electrical power available when the computer arrives.

The IBM system unit contains a power supply which provides power for the system board, adapter cards plugged into the board, two diskette drives, and the IBM Monochrome display. This supply requires one standard wall outlet, a 120-volt receptacle with ground, and draws a maximum of 2.5 amperes. Voltage is supplied to the IBM display from a special receptacle on the back of the system unit. Note that the IBM display *will not* plug in to a wall receptacle because the plug is not standard. It *must* be connected to the system unit.

If you have the IBM 80 CPS Matrix Printer (or any printer), you will need another 120-volt wall outlet, also with ground. The IBM printer draws a maximum of one ampere.

If you are using a TV or color monitor for your display, you will need another outlet. This will also be a 120-volt wall outlet. The current draw will depend on the particular display device.

If you have a small system and are using a cassette tape as your storage medium, you may have an AC adapter for the recorder. This will obviously require another 120-volt outlet, but will require negligible current.

To summarize, you will need a maximum of four outlets supplying 120-volt AC power. The system will draw somewhere between three and five amperes, depending on its specific configuration. All the outlets must be grounded. One more hint: ideally, your system should have its own circuit from your fuse box or breaker panel.

There is one other device you may want to consider adding to your system. Contemporary integrated circuit devices are growing denser and denser, and at the same time more sensitive to the power that supplies them. Severe voltage fluctuations can damage circuits in the computer. A further problem is "noise" from the power source, which interferes with the signals on the computer and can "confuse" the electronics. To protect against these problems, you may want to consider one of a variety of devices designed to "filter" noise and "isolate" your computer. Filters electronically reduce or eliminate stray signals from the power source. Isolators prevent power surges or "spikes" from getting through to the computer. Good isolators allow computers to operate through abominable conditions. I recommend that you talk this over with your local computer dealer and decide what is best for your situation. If the dealer doesn't have these devices, check with an electronics store—they're really quite common and you should not have difficulty finding one. A filter will cost from $25 to $100, and an isolator will cost from $50 to $200 depending on the current load it can support and the number of receptacles built into it. Multiple receptacles in the isolator are an advantage, since the isolator requires only one wall outlet but supplies power to several devices.

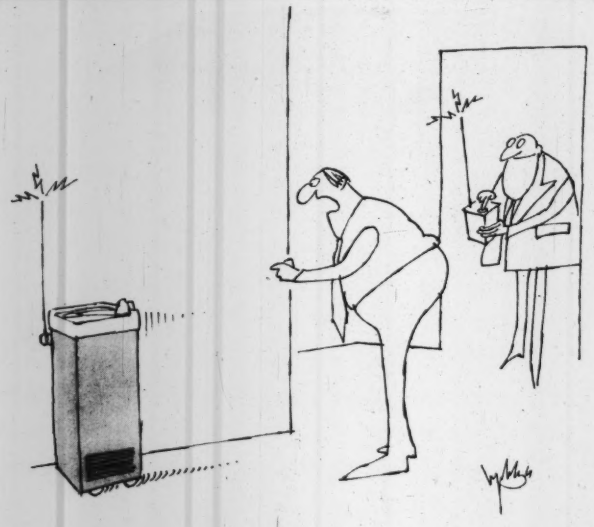
Attaching Your TV

The average consumer will probably connect the computer to the family TV set, or perhaps to a TV purchased specifically for the purpose. Either way, you're left with a small problem. IBM does not supply the RF Modulator, a device which is absolutely essential if you want your computer to talk to your TV.

Why doesn't IBM supply this little device? Well, home computers must pass an FCC test for various kinds of emissions, including radio frequency emissions. Keeping emissions low makes your computer friendlier, so your big, burly neighbor doesn't drop by to ask you why there are Galactic Invaders all over his football game. The purpose of the RF Modulator is to convert the standard composite video (NTSC) signal into a signal that the tuner in the TV set can receive. In effect, it's a small transmitter. It's a weak signal, which is why you have to attach the wire directly to your TV, but it does transmit. That makes it harder for the system to pass the FCC test, and it's tough enough already—and getting tougher.

You can get an RF Modulator at just about any computer store. One that is very popular and very available is the Sup'r'Mod II from M&R Industries, in Sunnyvale, CA. This RF Modulator is designed for use with the Apple II, but the specifications match the requirements of the IBM Personal as well. I've already bought one (yes, even with no computer—do you have to rub it in?) from a local store for $29.95.

It comes with relatively simple instructions and includes the interface unit, a seven foot coaxial cable, and an antenna transformer/switch box. The transformer attaches to the UHF antenna screws. The coax connects the transformer to the interface unit. The interface unit connects directly to a 4-pin "Berg" strip on the Color Graphics Adapter. The interface unit is small and has a strip of adhesive on the back so that it can be mounted in an appropriate spot inside the system cabinet. The IBM cabinet has an extra hole in the middle of the back, so the coax can be threaded into the cabinet to be attached to the interface unit. Once connected, the TV set must be tuned to UHF channel 33 to receive the transmission from the computer.



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IBM, continued...

Table 1. Sup'r'Mod II RF Modulator Pin Assignments.

IBM Color Graphics Adapter		Sup'r'Mod II RF Modulator	
Signal	Pin #	Pin#	Color
+12 VDC	1	4	Orange
not used	2	3	Red
Video	3	2	Brown
Ground	4	1	Black

There is only one catch. The pins on both the Berg strip on the Color Graphics Adapter and the Molex connector on the Sup'r'Mod II are numbered 1 through 4, *but the pin assignments are reversed.* If you choose this RF Modulator, consult the documentation delivered with your IBM system to be sure you orient the connectors properly. Table 1 lists the pin assignments involved. You shouldn't have too much trouble with this since the Sup'r'Mod II is constructed with different color wires leading to the Molex connector and the instructions tell you which wire is which.

If you found all this too much to bear, try to buy an RF Modulator from the dealer who sells you the computer, and have him install it.

Attaching a Cassette Tape Recorder

This is another thing that IBM doesn't do for you. But take heart: they did a better job of this one. They provide the interface and connector, but not the cable or the cassette player.

There is a connector on the back of the system unit which is used to attach a cassette tape recorder. It is a round connector with five pins and is called a "5-pin DIN" plug. This particular one is an *audio* DIN connector. (I've recently learned that there are different kinds of DIN connectors.) You connect a standard cassette recorder with a cable that plugs into this DIN connector and into the jacks of the recorder.

The cable you need can be obtained from Radio Shack. It is part number 26-1207, 5-pin DIN to 3-plug Audio, and lists for $5.95 in the RSC-6 computer catalog. It is the same one that is used on the TRS-80 Model III and the Color Computer. I haven't tried this yet, but I have looked at both connectors and they are the same.

You may need a cassette recorder as well. Any recorder will do, of course. Radio Shack sells one called the CTR-80A Cassette Recorder, part number 26-1206, that costs $59.95 and comes with the cable described above and an AC adapter. They also sell a compact one, the Minisette-9, part number 14-812, for $79.95; the cable and AC adapter are extra. It's the one they suggest for the TRS-80 Pocket Computer.

I don't know enough about cassette recorders to make a strong recommendation. You don't really need a tremendously expensive one, but don't buy a cheap one either. Try to hit the middle. And be sure you get one with an AC adapter—you'll save its cost in batteries. Again, ask the dealer you buy the system from for suggestions.

Joysticks! (@%?#*&?!&@#!)

I don't know about you, but I want to play games with my computer. So I *will* have joysticks. Unfortunately (what, again?), IBM does not supply them.

The reason for my deleted expletives is the trouble I've had collecting information on available joysticks. Of course, I've tested nothing since I have no computer. Nonetheless, I think I've found a couple that fit the bill.

Our old friend Radio Shack sells a pair of joysticks (that's right, two) for $24.95, part number 26-3008. They happen to meet the IBM specification, which calls for two "linear taper" potentiometers with a resistance range of zero to 100,000 ohms and a momentary contact button which is normally open. Great! Let's plug them in and play, right? Nope. There is one tiny problem.

The Radio Shack joysticks each have a male 5-pin DIN connector. (It is *not* the same one that is used on the cassette cable.) The IBM Game Control Adapter, to which joysticks or paddles are connected, has a female 15-pin "D Shell" connector. Guess what—these two kinds of connectors don't go together. I tried to find some Radio Shack connectors that would allow me to build an interface cable or box which would have a male D Shell connector on one side and two female 5-pin DIN connectors on the other. No luck, I'm sure this can be done, but Radio Shack doesn't carry the parts.

I have to thank the folks at The Keyboard Company, in Garden Grove, CA, who were kind enough to send out one of their Joystick II joysticks. The Keyboard Company is a division of Apple Computer and manufactures game paddles, joysticks, and the 10-key numeric pad for the Apple II. The Joystick II is a really good looking device with a very nice feel. The stick itself it not as wishy-washy as the Radio Shack joysticks, but it could be a little firmer. I lent the joystick to a friend of mine who owns an Apple and he said he was generally pleased after trying it out on a number of games.

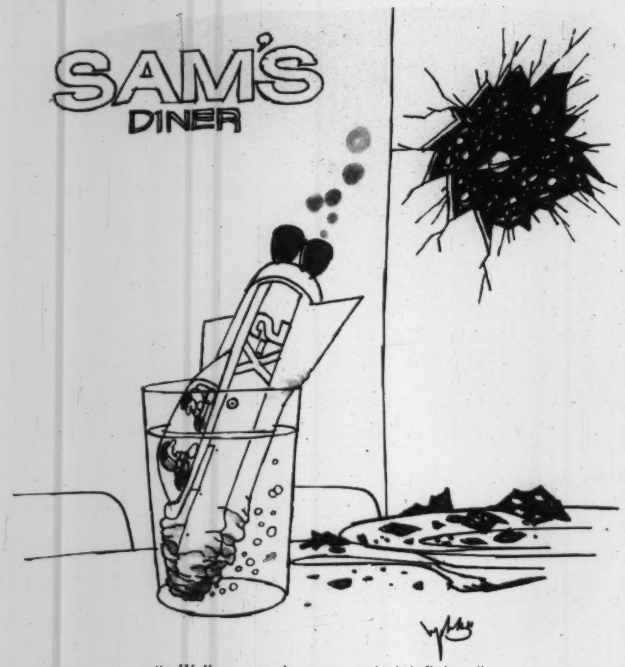

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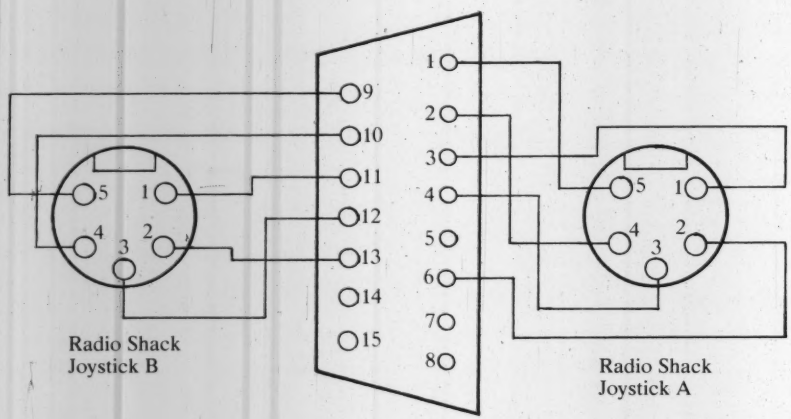
Figure 1. IBM to Radio Shack Joystick Wiring Diagram



Pin Assignments

IBM Game Control Adapter	
1	+5 volts
2	Button - Joystick A
3	X position - Joystick A
4	Ground
5	Ground
6	Y position - Joystick A
7	Button - Joystick A (second button)
8	+5 volts
9	+5 volts
10	Button - Joystick B
11	X position - Joystick B
12	Ground
13	Y position - Joystick B
14	Button - Joystick B (second button)
15	+5 volts

Radio Shack Joystick	
1	A (x) position
2	B (y) position
3	Ground
4	Button
5	+5 volts

Needless to say, Joystick II won't plug into the IBM either. The cable from the stick ends in a 16-pin DIP (dual inline package) plug and is designed to fit a DIP socket on the Apple II system board. As with the Radio Shack joysticks, you will have to build an adapter cable or box. In addition, the Joystick II does not quite meet the IBM specification, in that it ranges from zero to about 140,000 ohms.

This leads me to an interesting point. Any joystick which uses potentiometers (variable resistors) can be used with the IBM Game Adapter as long as you can get it connected. The amount of resistance from the "pot" determines the length of time a signal from the controller is left on. The software program must time the duration of this signal to determine the position of the joystick. The IBM Technical Reference manual gives a formula for this time as a function of the resistance:

TIME in microseconds = 24.5 + 0.011 * (RESISTANCE in ohms)

Therefore, at zero ohms the time is 24.5 microseconds and at 100,000 ohms the time is 1124.5 microseconds. The Joystick II, at 140,000 ohms requires a maximum of 1564.5 microseconds.

I am going to find out whether the IBM software, meaning Basic, can deal with an arbitrary maximum time, or whether it only times up to its specification of 1124.5 microseconds. I'll let you know.

I've listed the pin asignments for both joysticks and the IBM Game Adapter in Figures 1 and 2. I plan to try to connect whatever joysticks I can get my hands on to my system, whenever I get it. The Joystick II is the only one I have at the moment. Besides it and the Radio Shack joystick, I only know of the GSC Videostick, the Programma joystick, and the Peripherals Plus joystick. You'll hear about my progress.

By the way, the IBM Game Control Adapter will support four pots and four switches. This means either four game paddles with one button each, or two joysticks (two pots per stick) with two buttons per stick. Joystick II does, in fact, have two buttons. If you are interested in paddles, use my diagrams but "divide" them in half—a joystick is really two paddles.

By the way again, the Atari joysticks *will not* work on the IBM as they are switch type, not resistive.

Now, on to other matters.

The IBM Technical Reference Manual

I mentioned in my December Evaluation article that IBM planned to provide a reference manual which would include schematics. Well they did, and I thank IBM for making one available to me. This document should be available to the public now, and costs $36.

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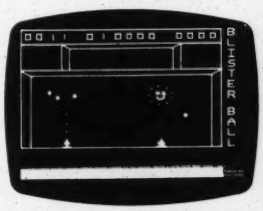

The disk also includes Mad Bomber. You must destroy the bombs as the bomb racks are filled, for if you don't stay ahead of them, you don't have a chance. Both games can be played solo or by two players, either against each other or as a team. Two games, on disk, (DOS 3.2), requiring 48K Apple with paddle controls. CS-4511 $24.95

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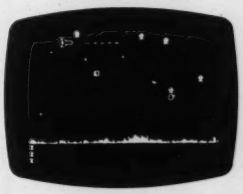

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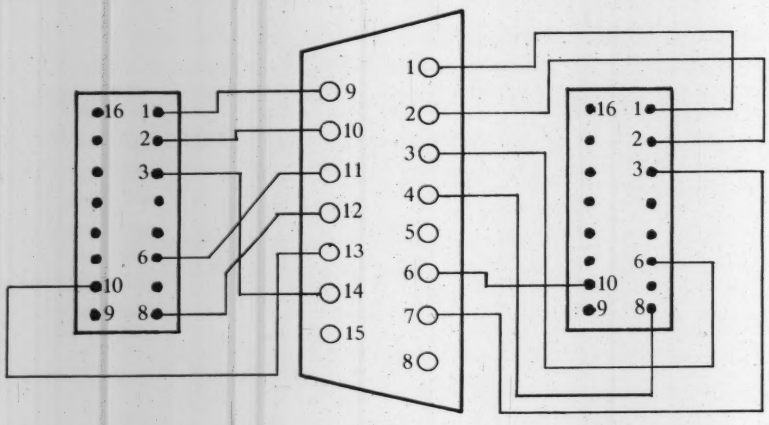
IBM, continued...

Figure 2. IBM to Joystick II Wiring Diagram.



Joystick II 16-pin DIP

IBM Game Control Adapter Male 15-pin D-shell connector

Joystick II 16-pin DIP

Pin Assignments

IBM Game Control Adapter

1 +5 volts
2 Button - Joystick A
3 X position - Joystick A
4 Ground
5 Ground
6 Y position - Joystick A
7 Button - Joystick A (second button)
8 +5 volts
9 +5 volts
10 Button - Joystick B
11 X position - Joystick B
12 Ground
13 Y position - Joystick B
14 Button - Joystick B (second button)
15 +5 volts

Keyboard Co. Joystick II

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3 Switch 1 (switch)
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8 Ground
10 Y position

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A week later Sears NJ Credit department called for additional credit information so they could increase my line of credit to the necessary $3500. A few days later, I got another call along the same lines.

The following week, Sears Credit called again to inform me that personal computers can't be ordered with a personal credit card but must be ordered using a company credit card. "But I'm buying the computer for me, an individual," I protested.

"Sorry, it will have to be paid for by a company credit card," Sears's Mr. Otterbeis replied. I gave him the Creative Computing company credit card number.

This is the last I heard. As each day ticks by, I wonder whom to call at the world's largest retailer or the world's largest computer company. I haven't found out yet.

In general, I would favor getting a computer system from a local outlet, particularly in view of later servicing needs (even on an IBM system). However, in this case we wanted a system as soon as possible so we could report on it to readers of *Creative Computing* and *Small Business Computers*.

Unfortunately, we found that buying from Sears is not the answer. Perhaps if I personally walked in with a certified company check . . . —DHA

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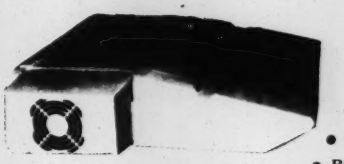

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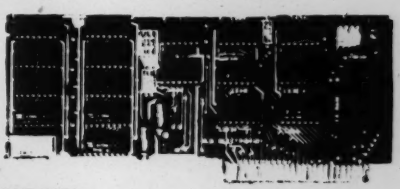

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CIRCLE 209 ON READER SERVICE CARD

Table 2. Contents of IBM Technical Reference Manual.

Section 1 - Hardware Overview

Section 2 - Hardware
- System Board
- Power Supply
- IBM Monochrome Display and Parallel Printer Adapter
- Color/Graphics Monitor Adapter
- Parallel Printer Adapter
- 5 1/4" Diskette Drive Adapter
- Memory Expansion Options
- Game Control Adapter
- Asynchronous Communications Adapter

Section 3 - ROM and System Usage
- ROM BIOS
- BIOS Cassette Logic
- Keyboard Encoding and Usage
- Low Memory Maps

Section 4 - Appendices
- A: ROM BIOS Listing
- B: Assembly Instruction Set Reference
- C: Of Characters, Keystrokes, and Color
- D: Logic Diagrams
- E: Unit Specifications

Glossary
Bibliography
Index

Table 3. IBM Personal Computer Physical Memory Map.

Start Address Decimal	Hex	Area Size (in Kbytes)	Allocated For:
OK	00000	64KB	RAM memory on system board
64K	10000	192KB	RAM memory on I/O channel (exp. slots)
256K	40000	384KB	RAM memory on I/O channel (future)
640K	A0000	16KB	IBM Reserved
656K	A4000	112KB	Graphics & Display Video Buffers
768K	C0000	192KB	Memory Expansion Area
960K	F0000	16KB	IBM Reserved
976K	F4000	48KB	ROM for Basic, BIOS, and self-test

Video Buffer Assignments

Start Address Decimal	Hex	Area Size (in Kbytes)	Allocated For:
656K	A4000	48KB	---
704K	B0000	16KB	Monochrome Display
720K	B4000	16KB	---
736K	B8000	16KB	Color/Graphics
752K	BC000	16LB	---

This manual is full of very detailed information about how the system is built and how it works. There is enough information for third party suppliers to learn how to build devices that plug into the expansion slots or write low-level software. This book also takes away the mystery of the ROM because a listing of the BIOS (basic input/output system) is included as an appendix. I've abstracted the table of contents in Table 2.

This manual is *not* a service manual. Not all the logic diagrams are included and there are no service instructions of any kind. IBM does have a service manual, but I'm not sure they will sell it to the public.

All That Memory...

I've talked before about the way IBM designed for the full megabyte physical address capability of the 8088 processor. The Technical Reference Manual has a map which shows the allocation of the memory. Table 3 shows the allocation.

It is possible to read and/or write any memory location in the machine using the Basic language. As in all versions of Microsoft Basic, the PEEK and POKE functions are available. However, for the IBM system they must be used in conjunction with the DEF SEG statement.

DEF SEG is used to establish a "base" address. When Basic begins execution, this base address is set to the beginning of the Basic workspace in memory. The statement "DEF SEG" restores this default. A statement of the form "DEF SEG = address" can be issued, where address is a value between 0 and 65535 and evenly divisible by 16. When an address reference is made with PEEK or POKE, the base address is multiplied by 16 (shifted left 4 bits) and added to the offset. This scheme allows each byte in the one million byte address space to be accessed.

Addresses are also required by BLOAD, BSAVE, CALL, VARPTR, and USR. The address calculation for these statements and functions is the same as above.

Although I have an aversion to PEEK and POKE, mostly on aesthetic grounds but also because they tie a program firmly to a specific hardware set, I understand their value. Next month I'll have a program which demonstrates their use.

News

IBM now has five product centers. Two new stores were opened in New York City last November.

Computerland is opening stores like crazy. I got a press packet containing announcements of 20 new stores they have opened. A new one also opened up very near my home and is the first one in the Baltimore area. □

Make the Most of Your ZX81 or 80

SYNC Magazine

SYNC, a bi-monthly magazine for users and prospective users of the Sinclair ZX80 computer has expanded its coverage to include the ZX81 as well.

Now entering its second year, **SYNC** has been providing nearly 10,000 Sinclair computer owners with information on how to make most effective use of their computers. "Resources," one of the most popular sections of the magazine, has listed over 100 second source vendors of software, peripherals and books as well as user groups.

Each issue of the magazine carries complete application programs, tips and techniques for more effective programming, hardware modifications and in-depth evaluations of software, peripherals and books.

Subscriptions to **SYNC** cost $10.00 per year (6 issues). **SYNC**, 39 E. Hanover Ave., Morris Plains, NJ 07950. (201) 540-0445.

The ZX81 Companion

The ZX81 Companion by Bob Maunder follows the same format as the popular **ZX80 Companion**. The book assists ZX81 users in four application areas: graphics, information retrieval, education and games. The book includes scores of fully documented listings of short routines as well as complete programs. For the serious user, the book also includes a disassembled listing of the ZX81 ROM Monitor.

MUSE reviewed the book and said, "Bob Maunder's **ZX80 Companion** was rightly recognized to be one of the best books published on progressive use of Sinclair's first micro. This is likely to gain a similar reputation. In its 130 pages, his attempt to show meaningful uses of the machine is brilliantly successful."

"The book has four sections with the author exploring in turn interactive graphics (gaming), information retrieval, educational computing, and the ZX81 monitor. In each case the exploration is thoughtfully written, detailed, and illustrated with meaningful programs. The educational section is the same—Bob Maunder is a teacher—and here we find sensible ideas tips, warnings and programs too."

Softbound, 5 1/2 x 8", 132 pages, $8.95.

The Gateway Guide to the ZX81 and ZX80

The Gateway Guide to the ZX81 and ZX80 by Mark Charlton contains more than 70 fully documented and explained programs for the ZX81 (or 8K ZX80). The book is a "doing book," rather than a reading one and the author encourages the reader to try things out as he goes. The book starts at a low level and assumes the ZX80 or ZX81 is the reader's first computer. However by the end, the reader will have become quite proficient.

The majority of programs in the books were written deliberately to make them easily convertible from machine to machine (ZX81, 4K ZX80 or 1K ZX80) so no matter which you have, you'll find many programs which you can run right away.

The book describes each function and statement in turn, illustrates it in a demonstration routine or program and then combines it with previously discussed material.

Softbound, 5 1/2 x 8", 172 pages, $8.95.

Getting Acquainted With Your ZX81

This book is aimed at helping the newcomer make most effective use of his ZX81. As you work your way through it, your program library will grow (more than 70 programs) along with your understanding of Basic.

The book is chock full of games such as *Checkers* which draws the entire board on the screen. Other games include Alien Imploders, Blastermind, Moon Lander, Breakout, Digital Clock, Roller-Ball, Derby Day, and Star Burst.

But the book is not all games. It describes the use of PLOT and UNPLOT, SCROLL, arrays, TAB, PRINT AT, INKEYS, random numbers and PEEK and POKE. You'll find programs to print cascading sine waves, tables and graphs; to solve quadratic equations; to sort data; to compute interest and much more.

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Personal Electronic Transactions

Greg Yob

On Review Lag

Every day there are more and more PETs in the world, and more and more new PET products. During my absence from these pages, over 30 new products have arrived at my door step—it will take me at least seven columns to get through all of these nifty items. As I am faced with rather tight space limits (3 pages per issue) many of the reviews will be short to allow some non-review material. If you are a manufacturer and want an in-depth review, let me know—but be aware that the lag will increase.

PET Hits the Ringer

We all know that our PETs will soon get modems and become attached to the telephone lines. Bill Mallison adds to the fun by providing some sound effects for the telephone ring and busy signals in Listing 1. Press the space bar to get back to Line 20. (By the way, Bill's sounds are quite realistic—and realistic sounds are hard to do. Don't try to change the Lines 110-160 or 210-270 as this will change the sound. The time taken by Basic to convert numbers such as 59467 is part of the sound.)

Phontasy Error

Many of you wrote about the Phone Number Words program in the September 1980 column. Unfortunately a rather subtle error appeared in the listing. The correction is:

```
180 P(J)=ASC(MID$(P$,J))-48
```

The column had P() as P$() which gives a ?TYPE MISMATCH ERROR. At least one reader thought that the bad value came from the right hand side—and Basic will happily create an array without a DIM statement for P$ which leads to all sorts of things, none of them good.

Educational Programs by Don Ross

I am becoming slowly convinced that programming is an art, and that educational programming is a fine art. If you look at history, especially the history of technology or art, it soon becomes clear that progress proceeds with a few large steps and thousands of tiny ones. Just to make your discouragement total, remember that the central architecture of the computer was conceptually complete by 1952 or so—the remaining 30 years of progress represent minor improvements on the idea.

Don Ross gave me three programs (Addition, 123 Digit Multiplication and Long Division—$20. each, available from Microcomputer Workshops, 10 Elizabeth Pl., Armonk, NY 10504) which are better than Microphys but still need some refinements. Each program uses the same basic idea—that the screen of the computer can serve as a "worksheet" on which one works the math problem just as he does with as pencil and paper. For example, an addition problem begins with a cursor in the lower right where you would put the first digit when solving the problem. Then the cursor moves to the top of the next column to the left for you to enter the carry value. Eventually all the values are entered and you can go to the next problem. This is a nice idea—I always hated to do this by pencil, erase, etc., with my work looking like something from the art class wastebasket—and the mechanics of writing digits gets in the way of solving the problem at hand.

The programs lack several things I expect in educational programs, however. First, the program isn't "stop-proof." In fact, the instructions ask the student to press STOP when finished. This is fine for the cooperative students, but just won't work for those of less refined habits. Second, INPUT is used—though Don takes some trouble to get around the RETURN problem, I found that Shift-RETURN followed by RETURN crashed the programs nicely. In education, *always* use GET—never INPUT. The STOP and GET considerations are needed to protect the teacher from the heedless or nasty student.

The entry of each digit is set up to permit only the correct value. On the first error, you are told that you didn't get it right, on the second error, you are given the correct value and told "when you understand your error, type the correct answer." This is fine advice if the student knows what he is doing, and useless if he doesn't. If you persist in entering wrong values, you simply continue through the "it's wrong" and "when you understand" cycle indefinitely.

When a carry value is zero, you must enter it anyways, which I found a bit annoying. Also, after each problem, you must specify its complexity. A better approach would be to ask how many problems, and then not require the complexity until the set of problems are done. A final complaint: if I hadn't done the Addition program first, I would not have understood the carry limitations at all, as these are explained in the Addition program only.

Programs by Teaching Tools

To my great surprise, Teaching Tools (Box 50065, Palo Alto, CA 94303) offers several educational programs which "do it right." If you are writing educational software, get these programs and take a long look at them; the methods used might prove useful to you.

The programs offered are: Addition, Subtraction, Spelling Package, Letters and Numbers, and Match Game. All except Spelling are $20. each. The Spelling Package comes with a box which attaches to the Cassette Port and User Port and is used to control a standard audio cassette player. Two versions of the box are available, one with a video output for slave monitors. The Spelling Package therefore costs $89. or $139. depending on the box you select.

It would take most of this column to describe why I like these programs, so I will mention just a few reasons. First, the programs are crash-proof. I couldn't crash them; the STOP key is disabled and GET is used throughout. In fact, random key-banging comes back with a STOP IT message, which is quite a surprise for a disdainful student. Second, animation and graphics are used when a task is completed, and the little critters that appear are different each time. Third, errors are clearly shown, and on a second error, the answer is indicated, but you still must enter the

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PET, continued...

Figure 1. SciTronics BSR Interface Wiring List.

RC-80 Cable	Function	PET	
1	Control 4	n/a	n/a = not applicable
2	n/c		n/c = not connected
3	Addr 10	n/a	
4	n/c		
5	Addr 13	n/a	
6	Addr 12	n/a	
7	Ground	n/c	
8	Addr 15	n/a	
9	n/c		
10	Addr 10	n/a	
11	Control 1	CB2	Acts as a 'strobe'
12	Addr 8	n/a	
13	n/c		
14	Addr 14	n/a	
15	60 HZ	CA1	60 Hz detection. Tie to Pin 6 of the 4538
16	n/c		chip which is on the upper left corner of
17	Data 4	PA4	the controller board.
18	Addr 9	n/a	
19	Data 7	PA7	
20	Control 3	n/a	
21	Data 1	PA1	
22	n/c		
23	Data 6	PA6	
24	Control 2	n/a	
25	Data 3	PA3	
26	Addr 0	n/a	
27	Data 5	PA5	
28	Addr 1	n/a	
29	Data 0	PA0	
30	Ground	Ground	
31	Data 2	PA2	
32	Addr 4	n/a	
33	Addr 3	n/a	
34	n/c		
35	Addr 7	n/a	
36	Addr 5	n/a	
37	Addr 7	n/a	
38	n/c		
39	Addr 2	n/a	
40	n/c		

To get the 60Hz signal, you must install a jumper from the 4538 chip to the tie point for Line 15 on the ribbon cable. If you don't understand this, don't try it. This signal is a TTL level and is *not* connected to the power line.

SciTronics Jumper Options:

Switches 1-7, 11-14	Off
Switches 9, 10, 15	Don't Care
Switch 8	On
Jumpers 1, 2, 7-9	No Connect
Jumpers 3, 6	Connect
Jumpers 4, 5	Position 3

+5 option — NO
C4, C5 to Cable — NO
RST — Tie to +5 volts

These settings set the SciTronics controller to use a parallel interface.

answer. There was a deep sense of patience in these programs. When I talked with Teaching Tools I learned that the programs were developed for learning disabled children. Care was taken to avoid a major problem in programming for the disabled—the trap of making a task of so many minute details that the result is hopelessly boring.

Hidden in the programs are some options which are described in the instructions only. The program gives instructions for use but not for changing difficulty or how to stop the program. That's in the user's guide for the parent or teacher. The paper instructions are quite clear.

Teaching Tools has made some comparative studies of their programs vs normal paper and pencil work. They say that students work about the same rate, but do twice as many problems with the computer in a typical session. So, get these programs, and if you write educational software, let them be a lesson for you.

BSR Wars Continued

In the last column (May 1981) I described how to connect the SciTronics BSR controller unit to the PET. This is summarized in Figure 1 for your reference. There is one additional change, which is to connect the CA1 line on the User Port to the 60 Hz detection circuit in the RC-80 controller board. This is done by jumpering a wire from Pin 6 of the 4538 (This IC is in the upper left corner of the board looking at the components side.) to one of the unused lines in the interface cable. The other end of this line is connected to CA1.

Once you have wired up the interface (this requires some experience with soldering irons and the like. If you aren't sure about this, get an *experienced* friend to do it for you—this is not a Heathkit!), get a BSR Lamp Control Unit which plugs into a wall socket. This will cost about $17. and can be found at good hardware stores or Radio Shack. Then, enter the SciTronics Demo Program in Listing 2.

This program uses a simple code for controlling BSR modules. The commands are:

H - House code (from A to P)
U - Unit code (from 1 to 16)
\+ - Turn lamp on
\- - Turn lamp off
> - Dim up (brighten)
< - Dim down (dimmer)
* - All units on
= - All units off
& - "and" units for one command
! - Reset SciTronics controller

If your module is set to House A, Unit 1, you would enter:
HA U1 + to turn lamp on
HA U1 - to turn the lamp off

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Cassettes. A thing of the past? You might think so by the number of software houses that have dropped them from their line in the past year or so.

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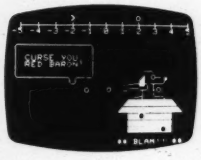

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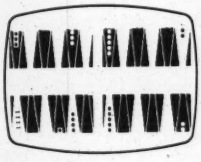

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PET, continued...

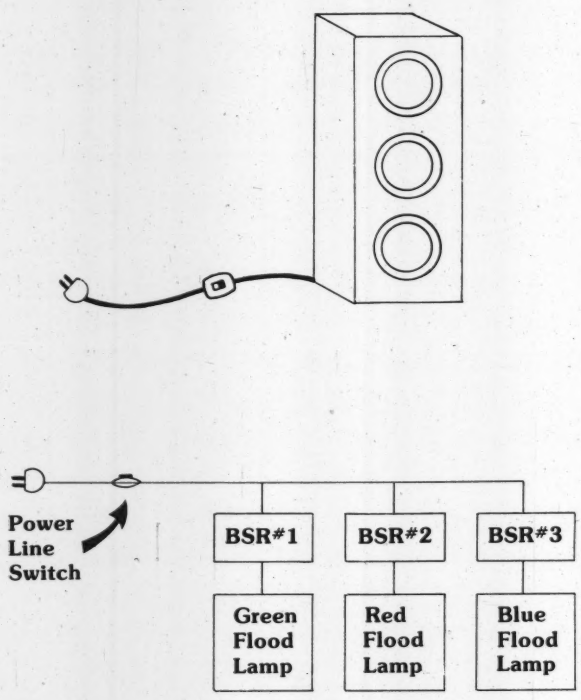
Listing 1. Bill Mallison's Phone Sounds.

```
PHONE RINGER
 10  REM BILL MALLISON'S RINGER
 20  INPUT"BUSYsp ORsp RINGsp ";A$
 30  IF A$="BUSY" THEN 110
 40  IF A$="RING" THEN 210
 50  GOTO 20
 100  REM BUSY
 110  FOR I=1TO250:NEXT
 120  POKE 59467,16
 130  POKE 59464,122
 140  POKE 59466,10
 150  FOR I=1TO500:NEXT
 160  POKE 59467,0
 170  GETA$:IFA$=""THEN110
 180  GOTO 20
 200  REM RING
 210  FOR I=1TO34
 220  POKE 59467,16
 230  POKE 59466,15
 240  POKE 59464,155
 250  POKE 59464,0
 260  NEXT I
 270  FOR I=1TO1000:NEXT
 280  GETA$:IFA$=""THEN210
 290  GOTO 20
```

Listing 2. SciTronics BSR Controller Demo Program.

```
SCI-TRONICS DEMO PROGRAM
 10  REM SCI-TRONICS BSR CONTROLLER
 20  REM DEMO PROGRAM
 30  REM OPERATES UP TO 256 BSR
 40  REM DEVICES
 50  REM
 60  REM BY GREGORY YOB
 70  REM
 80  REM STARTUP
 90  GOSUB 1000:GOSUB2600
 100  INPUT"clr HELPsp (Y-N)";A$
 110  IF LEFT$(A$,1)="Y"THENGOSUB3500
 120  GOSUB 3000
 130  INPUT"dn SEQUENCE:";S$
 140  REM
 150  REM PARSE COMMAND
 160  REM
 170  GOSUB 4000
 180  GOTO 120
 1000  REM * ARRAYS
 1010  REM
 1020  REM HOUSE CODES ARE:
 1030  REM
 1040  REM A-37  E-29  I- 5  M-61
 1050  REM B-33  F-25  J- 1  N-57
 1060  REM C-45  G-21  K-13  O-53
 1070  REM D-41  H-17  L- 9  P-49
 1080  REM
 1090  DATA 37,33,45,41,29,25,21,17
 1100  DATA 5,1,13,9,61,57,53,49
 1110  REM
 1120  REM UNIT CODES ARE:
 1130  REM 1-27  5-35   9-59  13- 3
 1140  REM 2-31  6-39  10-63  14- 7
 1150  REM 3-19  7-43  11-51  15-11
 1160  REM 4-23  8-47  12-55  16-15
 1170  REM
 1180  DATA 27,31,19,23,35,39,43,47
 1190  DATA 59,63,51,55,3,7,11,15
 1200  REM
 1240  REM FILL ARRAYS
 1250  REM HC IS HOUSE CODES
 1260  REM UC ARE UNIT CODES
 1270  REM
 1280  DIM HC(16),UC(16)
 1290  FORJ=1TO16:READ HC(J):NEXT
 1300  FORJ=1TO16:READ UC(J):NEXT
 1310  REM
 1320  REM MISC USEFUL VALUES
 1330  REM
 1340  DR=59459 :REM DATA DIR REG
```

Figure 2. Mood Lights.



The "Mood Lights" unit uses the three primary colors, red, green and blue to make a variety of colors by adjusting the lamp brightness via the BSR lamp modules. Use ceramic light sockets and be sure to provide some ventilation as the lights can get very warm. I built two units and placed them in opposite corners of a room. The PET can be elsewhere in the house.

The program remembers the last House and Unit code you used, so once you turn the lamp on, a simple "-" will turn the same lamp off.

If you get the SciTronics controller (I personally like the unit and hope this review prompts SciTronics to offer a prewired interface cable and the Demo Program to PET users), be sure to study the Demo Program carefully. The program handles the rather strange control codes required by the controller and several handshake difficulties that I don't have room to discuss in detail. In particular, Lines 2500-2550 and Lines 4140-4190 must be followed exactly. The controller tends to get into a state which needs a reset to allow new commands and this is handled in the 4140-4190 area. (Ignore this at the price of several hours of frustration!)

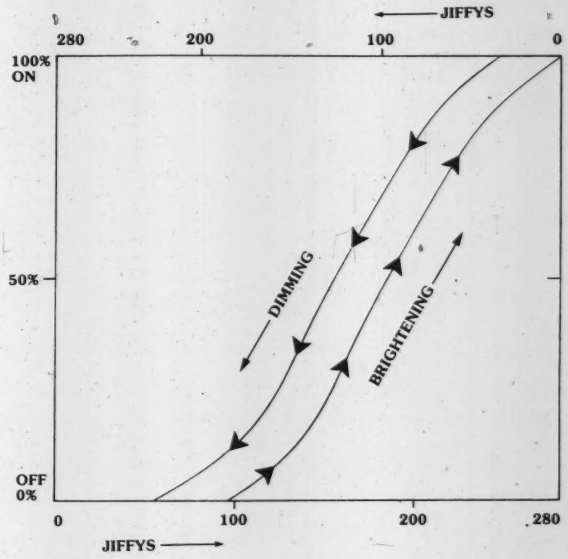
One small note about the listing—the asterisk in the REMarks usually means SET which is a token used by Disk-O-Pro. I haven't updated my PRINTER LIST program for Disk-O-Pro or BASIC4 tokens yet. INITIALIZE and NUMBER are also similarly hidden.

Once I had all of this working, I built some "mood lights" for use at parties and the like. Figure 2 shows a box with three colored floodlights (red, green, blue) which are controlled by lamp modules mounted in the box. A few keystrokes at the computer and I can alter the color moods of my home. Such power!

Those of you interested in home security can use the TI and TI$ functions of the PET to schedule the lighting sequences in your house to any degree of complexity

```
1350  PR=59468 :REM PERIPHERAL REG
1360  UP=59471 :REM USER PORT
1370  IR=59469 :REM INTERRUPT FLAG
1380  CL=204   :REM CB2 LOW
1390  CH=236   :REM CB2 HIGH
1400  ZR=0     :REM ZERO
1415  MX=192   :REM MASK BITS 6 & 7
1420  HC=HC(1) :REM DEFAULT HOUSE #1
1425  UC=UC(1) :REM DEFAULT UNIT #1
1430  REM
1440  REM * DATA DIRECTION REGISTER
1450  POKE DR,63
1460  REM * CB2 LOW
1470  POKE PR,CL
1480  REM
1490  REM CONTROLLER COMMANDS
1500  REM
1510  REM 0 'STOP' & CLEAR BOARD  0
1520  REM 1 TURN LAMP ON         18
1530  REM 2 TURN LAMP OFF        50
1540  REM 3 DIMMER - BRIGHTER    42
1550  REM 4 DIMMER - DIMMER      10
1560  REM 5 'AND' MORE UNITS     26
1570  REM 6 ALL LIGHTS ON        34
1580  REM 7 ALL LIGHTS OFF        2
1590  REM
1600  DATA 0,18,50,42,10,26,34,2
1610  REM
1620  REM FILL ARRAY CM() WITH COMMANDS
1630  REM
1640  DIM CM(7)
1650  FORJ=0TO7: READ CM(J):NEXT
1660  RETURN
2400  REM CONTROLLER HANDSHAKE
2410  REM A. * CB2 LOW
2420  REM B. *PUT HOUSE CODE HC
2430  REM C. * CB2 HIGH
2440  REM D. *PUT UNIT CODE UC
2450  REM E. * CB2 LOW
2460  REM F. * CB2 HIGH
2470  REM G. *PUT FUNCTION FC
2480  REM H. * CB2 LOW
2490  REM I. * CB2 HIGH
2500  POKE PR,CL:POKE UP,HC
2510  POKE PR,CH:POKE UP,UC
2520  POKE PR,CL:POKE PR,CH
2530  POKE UP,FC
2540  POKE PR,CL:POKE PR,CH
2550  RETURN
2590  REM CLEAR CONTROLLER
2600  POKE UP,0
2610  POKE PR,CL:POKE PR,CH
2620  RETURN
3000  REM DISPLAY INSTRUCTIONS
3010  PRINT"clr BSRsp CONTROLsp INSTRUCTIONS
3020  PRINT"dn dn sp sp Hsp -sp HOUSEsp CODEsp (A-P)
3030  PRINT"dn sp sp Usp -sp UNITsp CODEsp sp (1-16)
3040  PRINT"dn sp sp +sp -sp LAMPsp ON
3050  PRINT"sp sp -sp -sp LAMPsp OFF
3060  PRINT"sp sp sp >sp -sp BRIGHTENsp (1-300)
3070  PRINT"sp sp <sp -sp DIMsp sp sp sp sp sp (1-300)
3080  PRINT"dn sp sp *sp -sp ALLsp UNITSsp ON
3090  PRINT"sp sp =sp -sp ALLsp UNITSsp OFF
3100  PRINT"dn sp sp &sp -sp 'AND'sp UNITS
3110  PRINT"dn sp sp !sp -sp CLEARsp CONTROLLER
3120  PRINT
3130  RETURN
3500  REM GIVE INSTRUCTIONS
3520  PRINT"clr sp sp THEsp PETsp WILLsp DISPLAYsp Asp SUMMARYsp OF
3530  PRINT"dn THEsp VALIDsp BSRsp COMMANDSsp LIKEsp THIS:
3540  GOSUB 3020
3550  GOSUB 3900
3560  PRINT"clr sp sp WHENsp THEsp PETsp ASKSsp FORsp Asp SEQUENCE
3570  PRINT"dn ENTERsp SOMEsp SERIESsp OFsp THESEsp COMMANDS
3580  PRINT"dn FORsp EXAMAPLE:
3590  PRINT"dn sp sp sp sp HBsp U5sp +
3600  PRINT"dn sp sp sp sp sp sp sp sp HOUSEsp #B,sp UNITsp #5,sp TURNsp ON
3610  PRINT"dn SEVERALsp COMMANDSsp CANsp BEsp JOINEDsp TOGETHER
3620  PRINT"dn SUCHsp AS:
3630  PRINT"dn sp sp sp sp HAsp U3sp -sp U6sp &sp U8sp -sp HBsp U6sp >sp 100
```

Figure 3. BSR lamp module brightness curve.



When going from full on to the level you want, use the upper curve. If you start at fully dimmed, use the lower curve. To ensure that the Module is fully on or off, use at least 300 jiffys when you begin.

If you move up and down a lot, the level will drift and will be mostly fully on or off after a while. Go deliberately to full on or off to get "set" now and then to avoid this.

you want. Since Subroutine 4000 accepts the command string S$, just replace Lines 100 to 999 with your scheduling program.

BSR modules, by the way, are almost as mysterious as a new PET. If you want to try precise control of colors with the "mood lights," the BSR lamp module has around 100 levels of brightness. A "brighten" or "dim" of less than 36 will not change the level of the lamp. If you use more than about 250 jiffys, the Lamp Module ends up fully on or fully dimmed. If you set a level by starting at full on and going down, this will be a level different from starting at full dim and going up. For example, > 500 < 100 will leave you at about 70% of fully on. < 500 > 100 puts you at 10% of fully on. The useful range is about 280 jiffys, so < 500 > 180 should put you at 70% of full. It doesn't; you are at 45% full. If you go for 50 more jiffys, you will get to the 70% level. Figure 3 shows the Bright/Dim curve for a lamp module.

The expert could use the CA1 flag bit in the Interrupt Flags register to more precisely control the dimming intervals (the BSR commands are sent over the power lines at 60 Hz and the CA1 line can be used to count 60 cycles as they occur). This will not be in phase with the PET interrupts, but CA1 can interrupt the PET if you are really intrepid. I am content to dim all the way down and then go up to the desired point. □

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CIRCLE 180 ON READER SERVICE CARD

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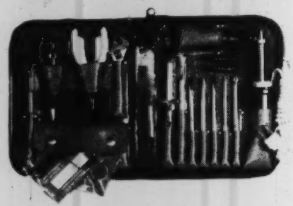

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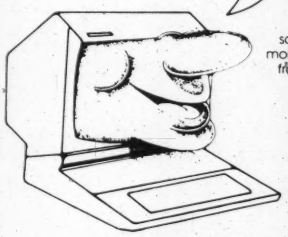
PET, continued...

```
3640  PRINT"dn SPACESsp ARENʼTsp REQUIRED,sp YOUsp COULDsp USE
3650  PRINT"dn sp sp sp sp HAU3-U6&U8-HBU6>100
3660  PRINT
3670  GOSUB 3900
3680  PRINT"clr sp sp sp SOMEsp THINGSsp TOsp NOTE:
3690  PRINT"dn 1.sp BEsp SUREsp TOsp ENTERsp THEsp HOUSEsp ANDsp UNIT
3700  PRINT"sp sp sp CODESsp BEFOREsp YOURsp FIRSTsp COMMAND.
3710  PRINT"dn 2.sp THEsp DEFAULTsp HOUSEsp &sp UNITsp ISsp HAsp U1.
3730  PRINT"dn 3.sp YOUsp MUSTsp TURNsp Asp LAMPsp ONsp BEFOREsp YOU
3740  PRINT"sp sp sp CANsp DIMsp IT.sp ONCEsp DIMMEDsp ANsp 'ON'
3750  PRINT"sp sp sp COMMANDsp WILLsp BEsp IGNORED.sp THEsp BEST
3760  PRINT"sp sp sp WAYsp TOsp SETsp Asp LAMP'Ssp BRIGHTNESSsp IS
3770  PRINT"sp sp sp TOsp TURNsp ITsp ON,sp THENsp DIM.sp IFsp ALREADY
3780  PRINT"sp sp sp ON,sp USEsp <400sp THENsp >sp TOsp THEsp DESIRED
3790  PRINT"sp sp sp LEVEL.
3800  PRINT
3810  GOSUB 3900:RETURN
3900  PRINT"dn sp sp sp >>sp PRESSsp ANYsp KEYsp <<"
3910  GETA$:IFA$=""THEN3910
3920  RETURN
4000  REM LOOK AT COMMAND STRING
4010  GOSUB 5000 :REM GET A LETTER
4020  IF P$=""THEN RETURN
4030  IF P$="H" THEN 4200
4040  IF P$="U" THEN 4300
4050  IF P$="+" THEN FC=CM(1)
4060  IF P$="-" THEN FC=CM(2)
4070  IF P$=">" THEN 4400
4080  IF P$="<" THEN 4500
4090  IF P$="*" THEN FC=CM(6)
4100  IF P$="=" THEN FC=CM(7)
4110  IF P$="!" THEN 4600
4120  IF P$="&" THEN FC=CM(5)
4130  IF V<0 THEN 4010 :REM IGNORE BAD VALUES
4140  REM * HC,UC,FC & PAUSE
4150  GOSUB 2500
4155  FORJ=1TO 500:NEXT
4160  REM CLEAR IF NOT READY
4165  PK=PEEK(UP) AND MK
4170  IF PK=192  THEN 4190
4180  GOSUB 2600
4190  GOTO 4010
4200  REM HOUSE CODES
4210  GOSUB 5000:IFP$=""THEN 4020
4220  N=ASC(P$)-ASC("@")
4230  IF N<1 OR N>16 THEN 4020
4240  HC=HC(N):GOTO4010
4300  REM UNIT CODES
4310  GOSUB 5500
4320  IF N<1 OR N>16 THEN 4020
4330  UC=UC(N):GOTO4010
4400  REM BRIGHTER
4410  GOSUB 5500
4420  IF N=0 THEN 4020
4430  FC=CM(3):GOSUB2500:T=TI
4440  IFTI-T<NTHEN4440   *
4450  GOSUB2600:GOTO 4010
4500  REM DIMMER
4510  GOSUB 5500
4520  IF N=0 THEN 4020
4530  FC=CM(4):GOSUB2500:T=TI
4540  IFTI-T<NTHEN4540
4550  GOSUB2600:RETURN
4600  REM CLEAR UNIT
4610  GOSUB2600:GOTO 4010
5000  REM EXTRACT P$ FROM S$
5010  P$="":IFS$=""THENRETURN
5020  P$=LEFT$(S$,1)
5030  S$=MID$(S$,2)
5040  REM REMOVE BLANKS
5050  IF P$="sp "THEN 5010
5060  RETURN
5500  REM EXTRACT * N
5510  N=0
5520  GOSUB 5000
5530  IF P$<"0" OR P$>"9" THEN 5600
5540  N=10*N+ASC(P$)-ASC("0")
5550  GOTO 5520
5590  REM RESTORE S$
5600  S$=P$+S$:RETURN
```

The Voice



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4:45 P.M. – Problem diagnosed using DIAGNOSTICS II.

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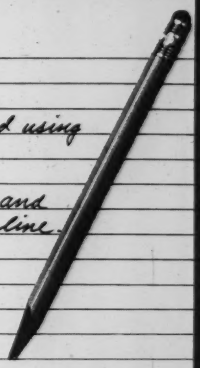

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CIRCLE 175 ON READER SERVICE CARD

strings...trs-80 strings...trs-8

Stephen B. Gray

Standing on the 37th rung of the TRS-80 ladder, we see ahead of us a CLOAD program that draws Lissajous figures, a Color Computer magazine, the Orchestra-85 music synthesizer with stereo and percussion, three Datasoft games (Iago, Football Classics, Arcade-80), and a very short program called Krazy-Keys.

Lissajous Figures

The "cover" of issue #17 of CLOAD magazine, dated July 1979, presents a different Lissajous figure each time it runs, due to three RND functions in the program, written by Robert Weaver of Santa Barbara, CA.

The Random House dictionary says Lissajous figures are named after French physicist Jules A. Lissajous (1822-1880), and are "the series of plane curves traced by an object executing two mutually perpendicular harmonic motions, forming a distinct pattern when the ratio of the frequencies of the motions is a ratio of small integers."

If you've studied electronics, you may know that you can get a Lissajous pattern on an oscilloscope screen by feeding various multiples of a common sinewave frequency into the X and Y inputs. From the shape of the figure, you can determine the relationship between the two frequencies.

You count the number of loops that touch the horizontal tangent line, and the number of loops that touch the vertical line, and the two numbers are the ratio of the input frequencies. If there are, as in the photo (Figure 1), five loops along one side and two along the other side, the frequency relationship is 5:2, such as would be achieved with inputs of 500 and 200 Hz, or 7,500 and 3,000 Hz.

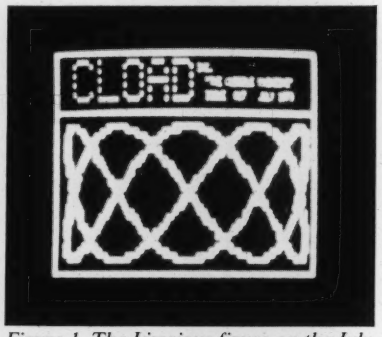

Figure 1. The Lissajous figure on the July 1979 cover of CLOAD magazine represents input frequencies with a ratio of 5:2.

In the program shown here, only the lines necessary to display the Lissajous pattern are retained from the much longer original. A is the horizontal-frequency factor, and B is the vertical-frequency factor. The third factor is C, the Z-axis factor, which might be thought of as the eccentricity factor.

```
100 CLS
110 I=0: J=0: A=RND(3)+1
111 B=RND(5): C=(RND(3)-1)*.7854
112 IF A>B THEN 110
113 IF A=B AND C=0 THEN 110
117 T=T+1: V1=63: V2=58
118 V4=30: V5=14: V3=6.6183
120 X=INT(V1+V2*SIN(A*I/V3+C)+.5)
130 Y=INT(V4-V5*SIN(B*I/V3)+.5)
140 IF POINT(X,Y) THEN J=J+1 ELSE J=0
150 SET(X,Y): SET(X+1,Y)
153 SET(128-X,60-Y): SET(127-X,60-Y)
156 I=I+1
160 IF J<30 THEN 120
```

If the two input frequencies A and B have a 1:1 relationship, the resulting figure will be a line, an ellipse or a circle, depending on where the value of C lies between zero and pi (Figure 2).

That is, the figure *would* be a circle if C were $\pi/2$, or 1.57, and if lines 120-130 were rewritten to get around the 3:7 aspect ratio of the pixel, which turns the circle into an ellipse. However, the author no doubt kept the 3:7 ratio because he needed to fit the figure into the lower two-thirds of the CLOAD cover, an area about seven by four inches.

You can examine the randomly-generated values by adding

```
115 PRINT @ 20, A;B;C
```

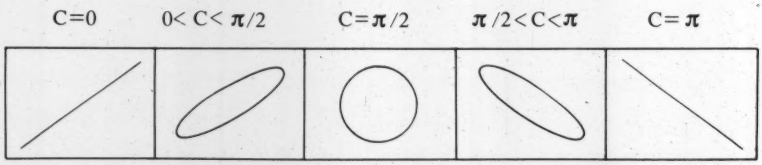

Figure 2. Chart of the Lissajous figures resulting from a 1:1 ratio of frequencies A and B, with values of C ranging from zero to pi.

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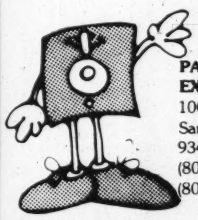

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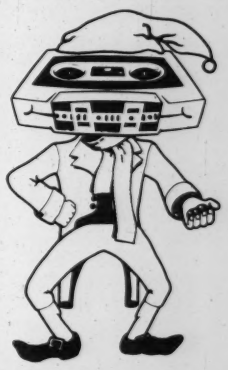

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or you can force the figures by adding

```
103 A=3: B=3: C=1.57
106 GOTO 115
```

and then changing the values of A, B and C to create different Lissajous patterns. For more on Lissajous figures, see a basic electronics textbook.

Sometimes a Lissajous figure has several "dead ends," for lack of a better phrase. For example, if the ratio is 3:2, you might have one loop and two dead ends on one side, and two loops and two dead ends on the other. Just count each pair of dead ends as a loop, which in this case gives you the 3:2 ratio.

What do the figures look like when C is greater than pi?

Incidentally, whether you use a ratio of 1:1 or 3:3 makes a difference in how the computer draws the figure initially. Use A and B values of 0.2 or less, and the figure will be drawn in one "pass," slower and slower as you use smaller and smaller values of A and B.

The V values in lines 117-118 position and scale the figure. The use of X and X+1 values for SET in line 150 creates the figures with a square made up of two pixels.

Line 153 may look as though it draws a mirror image of the figure, which is true, but the mirror image is drawn right over the original image, which is one way of drawing it faster. To see how this works, force an ellipse with lines 103-106, and you'll see the figure being drawn by two traces, one originating at 90 degrees and proceeding at 270 degrees and moving clock-wise. The figure is drawn in about 47 seconds.

Now add

```
152 GOTO 156
```

and the figure will be drawn with a single trace, and will take a little longer, maybe 60 seconds, to be completed. This double-trace method is something to keep in mind when drawing figures with polar coordinates.

©CREATIVE COMPUTING

"I hate to be the one to tell you this, but for the past hour and a half you've been trying to program our candy machine."

Lissajous in Color

This program can be adapted to the Color Computer by adding a third value to all the SET statements, by setting a value for it early in the program, and by cutting in half the X and Y values in lines 117-118 and 153.

However, because of the way pixels are turned on in the Color Computer, some of the Lissajous figures will be quite fanciful, and some others a mess. If you've got the 16K model, with Extended Basic, you can do some nice things with high-resolution figures, and on any model you should be able to take advantage of color for those figure-eight and pretzel-like convolutions.

Color Computer News

A 48-page bimonthly magazine, *Color Computer News*, has been published since last Spring. It is $9 for a subscription of six issues, from REMarkable Software (Box 1192, Muskegon, MI 49443).

The third issue contains a four-pager on using the DRAW statement, three and a half pages of a continuing series on 6809 machine code for those who like to probe the CC's innards, four pages on the CC ROM, several short programs, reviews of several CC programs, a three-page program that generates prime numbers, and 13 pages of ads.

There's no masthead listing the cast of characters, but presumably the editor is Bill Sias.

CCN is printed with a good matrix printer and contains enough of interest to be worth at least a year's subscription. Try it; you may like it.

Orchestra-85

The software music synthesizer of the 16K Model I TRS-80 called Orchestra-80 (Feb. 1981, p. 162; Oct. 1981, p. 246), has been improved and expanded into a new version, Orchestra-85, which features stereo and percussion.

Orchestra-85, priced at $129.95 plus $2 for shipping (Software Affair, 858 Rubis Dr., Sunnyvale, CA 94087) is also available as an upgrade to Orchestra-80, if you send in your PC board and $69.95 plus $2 for shipping.

Either way, you get the new, longer PC board, with twice as many components as the Orchestra-80 board, plus dual RCA phono jacks for stereo (Figure 3). You also get both tape and disk versions of the software on cassette, four sample music files, and an excellent 43-page manual.

Orchestra-85 supports clock rates from 1.77 to 4.0 MHz; the manual notes that

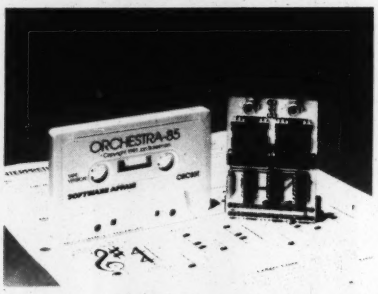

Figure 3. The Orchestra-85 PC board contains five ICs and four resistor networks. The printed page is from a chapter that shows non-musicians how to use the synthesizer's notation.

the quality of the sound rises with the clock rate, and falls with the number of voices used. Thus "a five-voice, 1.77-MHz synthesizer will have very limited high-frequency response and is not recommended."

The signal-to-noise ratio has been improved by 6 db, and helps improve sound quality by cutting down on the "aliasing" or unwanted harmonics, but they're still there.

The fifth voice, violin, has been added for five-part harmony, in addition to Orchestra-80's trumpet, oboe, clarinet and organ.

Stereo separates by instrument; you can play any instrument on either channel, such as trumpet and oboe through channel A and clarinet and organ through channel B.

Instrument Definition

The 85 manual is basically the same as the 80 manual, with the addition of various improvements and new features, such as forward and reverse global string search (to find a particular place in a file, after you've written a piece), append (to combine separate music files), and multiple-get ("allows perpetual play of several music files...useful in background-music applications").

The totally new section in the manual is on instrument definition, which includes percussion. The section tells how to change the tone-color registers, which are based on spectral analysis of orchestral instruments, and which are defined by the sum of eight sinewaves. Each partial is an integral multiple of the fundamental frequency, and the eight digits in the parameter list define the relative strength of each partial in the register, much like the drawbars of a Hammond Organ.

If you'd rather not get into setting up your own voices, each tone-color register has default values, which create the approximate tones of a trumpet, oboe, clarinet, organ, and violin.

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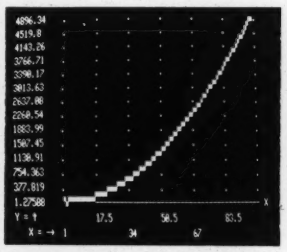
Graphic Package

CS-3301 Cassette (16K) $19.95
CS-3801 Diskette (32K) $24.95

This package provides a variety of interesting and useful graphing routines. Graphing Package combines text and TRS-80 graphics to plot a variety of functions and other graphs.

1. Bar Graph

Bar Graph plots graphs for up to six different categories. An optional display does conversion to a line graph.

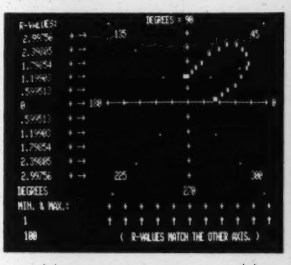


2. Cartesian Coordinate Graphing

This program plots a standard X, Y graph from a user entered function. A special feature of this program automatically scales of the Y-axis.

3. Polar Coordinate Graphing

Rarely found in computer graphing packages, this polar



graphing program provides plots of polar functions. The program labels all axes, features automatic scaling, and lets you input the range and increment of the plot. A unique and valuable program.

4. Parametric Graphing

Parametric functions are functions in which both x and y are expressed in terms of an independent variable t. The resulting graph is X vs. Y. This program allows the user to input two parametric functions and produces a graph.

5. Linear and Parabolic Regression

These two programs are used for data analysis which can later be entered into the graphing routines. Regression routines analyze how well a series of points fit on a linear or quadratic function.

Advanced Statistics

CS-3303 Cassette (16K) $24.95

CS-3505 Disk (32K) $24.95

This package may be the ultimate in statisical applications for the TRS-80. Advanced Statistics will provide you with the ability to perform statistical tests never before available on small computers. Its cassette based data file system allows you to store, retrive and transform data files for use in several different tests.

1. File Manager

File Manager, the heart of the statistical file management, allows you to create, edit, and transform data files. Unique to this program are features that allow the user to perform transformations on variables, extract and create subfiles, and selectively copy records. Up to twenty variables and an unlimited number of cases can be processed.

2. Descriptive Statistics

Descriptive Statistics computes the mean, standard deviation, standard error of estimate, variance, skewness, kurtosis, range, median, and quartiles for a variable and constructs a histogram for each value. A test scoring option for conversion of raw scores into percentiles is included.

3. Two Variable Statistics

This program calculates descriptive statistics for each variable. It performs a t-test for the difference of means, computing the product-moment correlation coefficient and its associated significance level. In addition, it performs linear regression and computes standard error of estimate for Y.

4. Crosstabulation

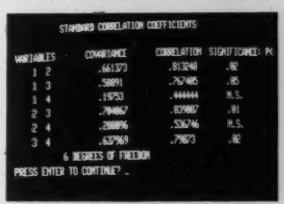
This program constructs contingency tables for displaying frequencies, column percentages and table-wide percentages for each cell. It computes the Chi-square, the level of significance and gamma statistics. Tables as large as 10x10 may be evaluated.

5. Regression-Trend Analysis

This program computes least-squares regression coefficients from time-series or paired data for best-fit equations (linear, parabolic, hyperbolic, logarithmic, power, exponential and cubic types). Calculates standard error of estimate for each equation and more.

6. Multiple Linear Regression

Performs multiple linear regression using up to ten independent variables. The program computes both unstandardized and normalized coefficients, covariance, multiple correlation coefficient, and the standard error of estimate.



7. Correlation Analysis

Computes product-moment correlation matrices, multiple correlation coefficients and partial correlation coefficients with their associated significance levels.

8. Analysis of Variance

This program performs one-way and two-way analysis of variance for a maximum of ten groups in each control variable. Statistics include the mean and standard deviation for each group, sum of the squares, degrees of freedom, mean square, F-ratios, and significance level.

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Percussion

When I first heard that Orchestra-85 included percussion, I thought that meant you'd specify a snare drum playing rolls, for example, or kettledrums playing heavy boom-bim-booms.

But using Orchestra-85's percussion is much more line defining the tone-color registers. There are no default values, such as one for bass drum, another for gong, etc. Instead of defining partial harmonics, the eight digits define random seeds and randomizing functions. "Because there are billions of combinations of seeds and functions, few generalizations can be made about the kinds of percussive effects available," says the manual.

A few samples are given: one sounds scratchy (003005); another squeaky (10100001); a third one, a sinusoidal waveform, like wooden blocks (80011001).

The percussion registers are toneless; "Just as you would not attempt to play a melody on a drum, you should not try to play music on a percussion register."

A short demonstration you can enter via Orchestra-85 shows what can be done with percussion. A later page provides 18 percussion samples, without defining what the author thinks they sound like.

"Stereo mapping" allows you, by using mapping symbols, to "balance or position voices in each stereo channel or to 'ping-pong' voices between channels."

The manual is a little skimpy on what the percussion feature can do, and how to use it. The reason, according to Software Affair president Bryan Eggers, is that percussion "is the last feature we put in. It was a matter of time; we decided to release it as it was. We're working on a newsletter, which maybe we should call an advanced programming guide, to send to users. We have a couple of dozen subjects, such as how to use percussion, additional effects, etc."

Eggers said there is "one undocumented command in Orchestra-85. If you are playing a piece and hear a sour note, and you want to find that note, you play the piece again, using the zero key to stop it at the bad note.

"Then you hit @, and for a moment everything freezes, while the program compiles to where you stopped. Then you use the SHIFT/BREAK keys, which puts you into edit mode right at the place you stopped."

This feature was originally put in by the author, Jon Bokelman, as a debugging routine, and is not in the manual.

Sound of Orchestra-85

None of the first three sample tunes, Haydn's *Gypsy Rondo*, *Entry of the Gladiators* (the old circus tune), or Monte's *Czardas*, uses percussion. The third, Stephen Foster's *Camptown Races*, does, just a little, and it's something like the sound effects in early Mickey Mouse films.

The percussion samples on page 41 sound like the clicks, pops and beeps more associated with robots than with music. Perhaps the newsletter will define some of the more recognizable percussion sounds.

The stereo of Orchestra-85 isn't true stereo, through which you should be able to hear, on each channel, a little of the opposite channel. Instead, the voices are heard *only* on the channel to which they are assigned, and thus often sound extraneous.

Incidentally, any music files written with Orchestra-80 will load in Orchestra-85, and play in stereo automatically.

And in Closing...

If this seems like a lot of space to devote to a music synthesizer, it's because the 80 and 85 seem to be the only such polyphonic devices now available for the TRS-80. Music Box (Oct. 1981, p. 244) hasn't been advertised for months because the manufacturer, Newtech Computer Systems, doesn't think it's competitive with Orchestra-80 or -85.

So, despite a few minor shortcomings, Orchestra-85 is well worth a look-see (look-hear?) if you're interested in a TRS-80 music synthesizer that can play more than one voice at a time.

You can do the Music Minus One type of play-along, by changing the loudness of a register to zero. The software, according to Eggers, is compatible with every known DOS for Model I, and in every single- and double-density configuration, "even LDOS."

He also says that "at least two dozen bulletin-board systems (plus three separate databases on Micronet) now offer free downloading of Orchestra-80/85 music files, "which requires an RS-232 board, modem, and terminal software. By the time you read this, Software Affair will probably have released Orchestra-90, for the Model III, with features identical to the Orchestra-85 for Model I.

Software Affair has released Volumes One and Two of their *Greatest Hits*, which are pre-programmed files, ready to load and play: $10 for each cassette of eleven classic music files, or all 22 on one disk for $20.

"You should have gotten suspicious when he said it had no moving parts."

Three Datasoft Games

Several challenging games for 16K Level-II Model I and III TRS-80 are available at $24.95 for disk, $19.95 for tape, from Datasoft (16606 Schoenborn St., Sepulveda, CA 91343), which also has word-processing, LISP, graphics and other such programs for various personal computers.

Iago

Iago (for Model I and III) is accompanied by a four-page leaflet (as are the other two) which says the game is "the classical Shakespearean challenger to Othello," goes back to the game of Reversi, and "continued into the 20th century when it developed into its modern incarnation in Asia." Actually, Iago is the same as Othello, which is the same as Reversi.

The object is to "outflank" (arrange your tokens on each side of) your opponent's (the computer's) tokens; you capture them in rows, and then flip them over to your color.

The game has seven layers of difficulty; at the top level, a game can take up to 20 hours. If you have an expansion interface, Iago displays the time you've taken to make your present move, and the total time taken by each side.

The game is deceptively simple, as you outflank your opponent's tokens one after the other. Then the tide begins to turn, unless you've managed to foresee the edge traps, and your legal moves dwindle down to a precious few.

Before long, you're hopelessly behind. So you play and play, looking for the winning strategies, but somehow the computer is always a step or two ahead of you.

Warning: This game is highly addictive. Don't buy it if you're easily upset, or have high blood pressure.

Football Classics

Setup takes a while with Football Classics (for Model I and III). You select from two to six teams, give them names, then provide names for the players (13 starters, six reserves). *Then* you enter statistics for each player, such as passes, completions, rushes, etc., plus team statistics. After which you do it all over again, for each of the other teams. You then save all this data on tape or disk, and verify the recording.

You switch to the *play* program, read in the data files, make last-minute player changes, and a gridiron is displayed on the top half of the screen, with yard lines, scoreboard and clock.

The ball is a pixel that moves back and forth on the playing field as you decide to punt, make a pass (short, long, screen, spot), make an end run, hand off to a player, etc. You spend most of the game looking at the 12-item menu, which may be OK if you're into playing football via menus, but there's much more real excitement in one of those little hand-held electronic football games.

Arcade-80

For the Level-II Model I you can get three games in a package called Arcade-80: Astro, Falling Bricks, and Star Run.

The object of Astro is to win points by destroying as many space mines as you can before you run out of fuel. You use the four arrow keys to turn the spacecraft, Shift to move it, the spacebar to fire.

You've got only about 90 seconds to destroy 20 to 30 large mines, except that 50 to 60 small mines are in the way of the large ones. So you shoot and move, shoot and move, improving your coordination as you go, but just when you've got only a couple of large mines left, you run out of fuel. So you play another game, and another, and another, trying for a bigger and bigger score, trying to get over 400, then over 500, then over 600....

Falling Bricks

As the first display puts it, "145 bricks poised at the top of your screen slowly begin to fall towards your defense line. It is up to you to destroy the bricks before they reach the bottom." You move left or right, and launch missiles. Sound familiar?

This is a very frustrating game, because it's timed so that if you make more than just a couple of small mistakes in moving your missile launcher or in shooting, you have no chance to destroy all the bricks before the rest fall on you.

This game is definitely out for anybody with heart problems. Especially since, right after the harrowing experience of destroying 145 bricks in the nick of time, you have to do it all over again, and again, and again.

Star Run

You've "just escaped from the dark star, and must try to out-run and destroy the galactic tie-fighter. You are equipped with a targeting computer and a laser...."

This is for experienced computer game-players who can watch several places on the screen simultaneously: the display of enemy ships, the gauge that indicates if the laser weapon is overheating, and the targeting-computer display.

Don't even try this one unless you've got several hundred hours of flight time on similar games, or are a natural-born space jockey with killer instincts.

Short Program #26: Krazy-Keys

Dan Rollins, of Azusa, CA, sent his "version of Krazy-Keys which uses a VARPTR trick:

```
0 'KRAZYKEYS -- BY DAN ROLLINS
10 A$="": V=VARPTR(A$)
20 POKE V,255      ' LENGTH OF A$
30 POKE V+1,0      ' POINT A$ AT
40 POKE V+2,56     ' KEYBOARD MEMORY
50 PRINT @ 0,A$;   ' MOVE IT TO
60 GOTO 50         ' VIDEO
```

"Just RUN the program and start pressing different combinations of keys. It can be mesmerizing. Try SPACE,A,S,D; alternate on the Q with your pinkie.

"One note... NEWDOS80 uses several key combinations for various interrupts (JKL, DFG, 123). There is no provision to nullify this. Also, some key combinations, as well as the BREAK key, will cause a BREAK."

The more keys you press at once, the weirder the display. This is a great program for children. □

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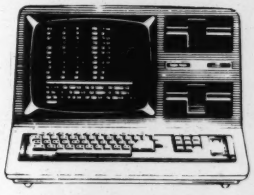

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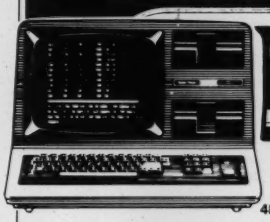

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APPLICATIONS SOFTWARE

MUSIC AND GRAPHICS

Grafpak is a family of high-resolution graphics dump programs for use with Apple II computers. It will dump either hi-res page horizontally or vertically, or both pages butted vertically. Grafpak is available for Epson, Anadex, IDS and NEC printers. Prices range from $29.95 to $39.95. Smartware, 2281 Cobble Stone Ct., Dayton, OH 45431. (513)426-3579.

CIRCLE 351 ON READER SERVICE CARD

Superplotter is a graphics package for applications in business, engineering, education and math. The Apple disk features pie graphs, bar charts, point and line graphs, a mathematical function file editor. $59.95. Dickens Data Systems, 433 Greenwood Dr., LaPlace, LA 70068. (504) 521-8744.

CIRCLE 352 ON READER SERVICE CARD

A programmable **character set** and game graphics editor has been introduced by Commodore Business Machines for the VIC 20 computer. The cassette comes with a 16-page instruction manual, and allows the user to create groups of 64, 128 or 192 programmable characters for use in Basic programs. $14.95. Commodore Business Machines, Inc., Computer Systems Division, 681 Moore Rd., King of Prussia, PA 19406. (215)337-7100.

CIRCLE 353 ON READER SERVICE CARD

The **VIC Piper** allows users to compose, save, recall and play back music on the VIC 20. Volume and tempo can be varied. $25. A **hi-res utility** for the VIC provides 104 x 152 plot positions, and a **multi-color utility** on the same cassette provides additional color on the 52 x 76 screen. $20. Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510. (616)241-5510.

CIRCLE 354 ON READER SERVICE CARD

Computer Station announces **Graphic Writer** for the Epson MX-80 (with Graftrax) and MX-100 printers. The program is designed to be used in conjunction with Apple Writer to obtain different type styles on graphics printers. It is also available for Silentype and Paper Tiger printers, and requires DOS 3.3, DOS Tool Kit, Applesoft and a supported interface card. $34.95. Computer Station, 11610 Page Service Dr., St. Louis, MO 63141. (314)432-7019.

CIRCLE 355 ON READER SERVICE CARD

WORD PROCESSING

The **Refware Thesaurus** is designed to help writers choose the most appropriate words to express a specific idea. A total of 12,400 nouns and adjectives are arranged in associated groups; when the user types a word into the computer, the program responds with suggestions of from 9 to 45 synonyms or associated words. Separate programs are available for nouns and adjectives at $39.95 each. The Refware Thesaurus Builder, which chains together eight utility programs to enable the user to create a specialized thesaurus specific to the needs of a profession or business, is priced at $149.95. All require a 48K TRS-80 Model I or III and two disk drives. Refware, P.O. Box 451, Chappaqua, NY 10514. (914)238-8896.

CIRCLE 356 ON READER SERVICE CARD

Telewriter is a word processing program for the TRS-80 Color Computer. It upgrades the standard 32 x 16 screen display to 51 x 24, and adds lower case characters. The program can use cassette or disk for storage, and features a special cassette handler with auto-retry on I/O error. It runs in 16K or 32K and requires no hardware modifications. $49.95. Cognitec, 704 Nob Ave., Del Mar, CA 92014. (714)755-1258.

CIRCLE 357 ON READER SERVICE CARD

DATA BASE MANAGEMENT SYSTEMS

Jinsam is a data base manager for Commodore CBM 8032/CBM 4032 computers. Jinsam 1.0 provides file handling, manipulation and report generation. Jinsam 4.0 for the CBM 4000 series adds a list maintenance feature with an unlimited number of fields and unlimited record length. Jinsam 8.0 for the CBM 8000 series includes the 4.0 features plus unlimited sort, horizontal format and search by key or record number. Jinsam 8.2 expands the capabilities of 8.0 by adding information search by word, key or record number and machine language print, format and manipulation routines. Among the interface modules available are Wordpropack for the WordPro word processing system and Interac which can read both Visicalc and WordPro files. Jini Micro Systems, Inc., Box 274 Kingsbridge Station, Riverdale, NY 10463. (212)796-6200.

CIRCLE 358 ON READER SERVICE CARD

GAMES AND RECREATIONAL

Acorn Software announces **Astroball**, a pinball game with a space theme for 16K TRS-80 Model I and III computers. It features space craft, flying saucers and black holes which can devour the player's ball. Available on tape or disk for $19.95. Acorn Software Products, Inc., 634 North Carolina Ave., S.E., Washington, D.C. 20003. (202)544-4259.

CIRCLE 359 ON READER SERVICE CARD

Artworx Software introduces nine programs for Atari computers. They include space games (**Encounter at Questar IV**, $23.95; **Rocket Raiders**, $19.95; and **Space Trap**, $14.95), a landing simulator (**Pilot**, $16.95), a **blockade** game ($14.95), two adventures (**Cranston Manor**, $21.95 disk and the **Vaults of Zurich**, $21.95), a **text editor** ($39.95, disk), and a player-missile editor (**PM editor**, $29.95). Artworx Software Company, 150 N. Main St., Fairport, NY 14450. (800)828-6573 or (716)425-2833.

CIRCLE 360 ON READER SERVICE CARD

COMPUTERS

Multi-User System for Sorcerer

Multi-Net 80 from Exidy Systems brings multi-user capability to the Sorcerer.

The system consists of a timeshared global processor and up to 16 users which are

basically single-user microcomputers (Z80 cpu and 64K RAM memory) communicating with the global processor (via high-speed block transfer) over the system bus.

The Multi-Net 80 supports 8" Winchester hard disk drives in one to eight increments of 45 megabytes each.

A single-user Multi-Net 80 system costs $6,000, an eight-user Multi-Net 80 system costs $24,500 and a sixteen-user Multi-Net 80 system costs $34,100.

Exidy Systems, Inc., 1234 Elko Dr., Sunnyvale, CA 94086. (408)734-9831.

CIRCLE 361 ON READER SERVICE CARD

Microcomputer Introduced By Zenith

Zenith Data Systems announces the Z-90 microcomputer.

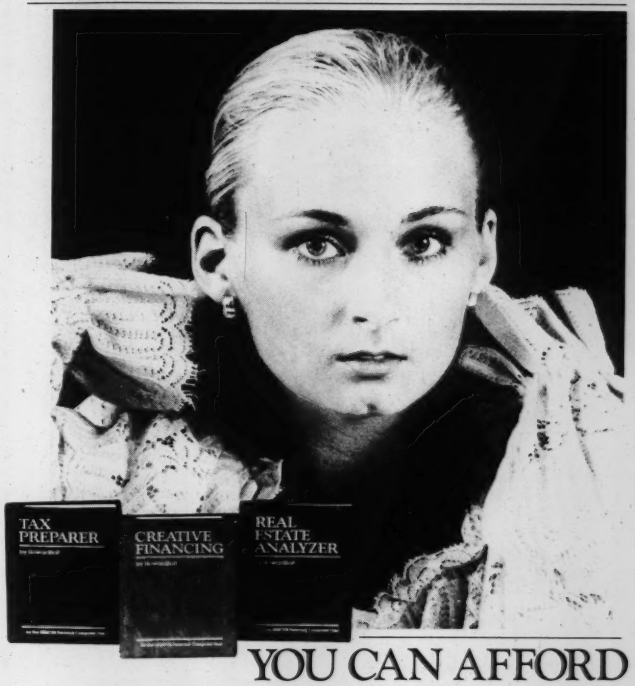
The Z-90 has a double-density disk controller card, which increases storage available on 5 1/4" diskettes and comes with 64K bytes RAM.

Models of the Z-90 with a built-in disk drive have a suggested retail price of $3,195. Those with no built-in disk drive have a suggested retail price of $2,895.

Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025. (312)391-8181.

CIRCLE 362 ON READER SERVICE CARD

THE EXPENSIVE SOFTWARE



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CIRCLE 150 ON READER SERVICE CARD

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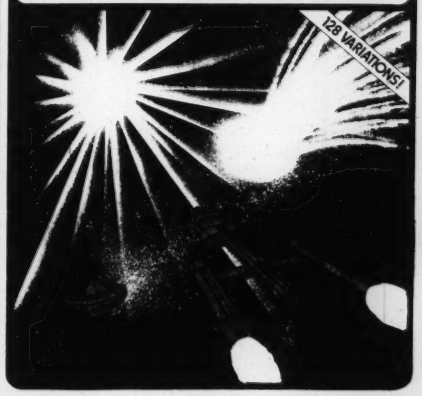

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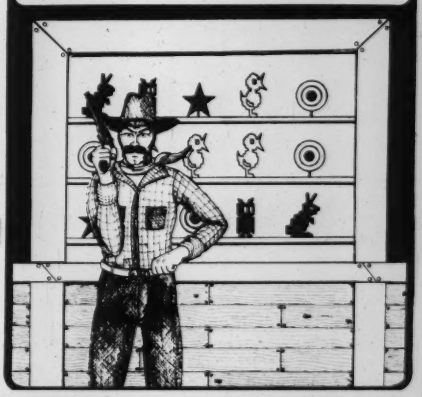

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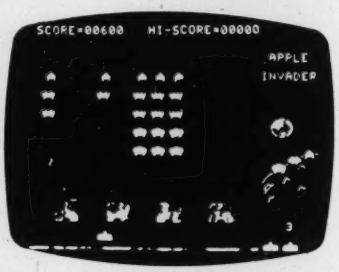
We've also got a nifty board game, *Computer Rage*, sets of three binary dice, acrobatic toy robots, T-shirts and lots of other goodies.

You'll find comprehensive descriptions of all of our software, books, games and peripherals in our huge 48-page catalog. It's unique in the small computer field. For your free copy, write or call us today or circle our number on the reader service card.



Super Invader features superb high-resolution graphics, nail-biting tension and hilarious antics by the moon creatures.

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CIRCLE 213 ON READER SERVICE CARD

New Products, continued...

Video/Computer System

VidCom makes possible the interaction of recorded video taped programs and courses with computers, such as Atari 800, Apple II, PET, TRS-80 and others.

The Vidcom System consists of a Vidram board, which plugs into the computer memory channel, a videocassette recorder with connecting cable to the Computer Vidram board, a personal computer, and a program to interact with the VTR.

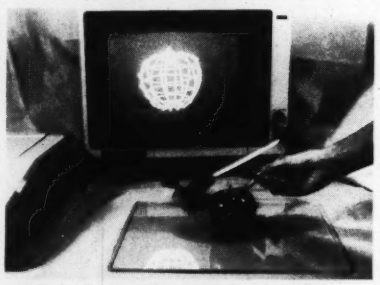
Prices are as follows: Vidram board, $395; VCR modification, $195; 48K Atari 800, or Apple II, with audio cassette recorder, including the Vidram board, a VTR modified with wiring and cable to connect to the Vidram boards $3,595.

VidCom Inc., Andre Lane, Peekskill, NY 10566. (914)737-7011.

CIRCLE 363 ON READER SERVICE CARD

PERIPHERALS

3-D Graphics Tablet



Micro Control Systems, Inc. and Penguin Software have announced a 3-D graphics tablet for the Apple.

The tablet surface is 16" by 13", with two-dimensional workspace approximately proportional to the Apple screen. The arm is located at the top center of the tablet, and has an "elbow" that allows it to swivel on the two-dimensional surface. It can also rotate up and down, giving it access to the area above the tablet. All the joints can rotate almost a full 360 degrees.

Included with the software package is a machine language subroutine that can be added to the user's program to allow the tablet to be polled for coordinates. $395.

Penguin Software, Box 432, West Chicago, IL 60185. (312) 231-0912.

CIRCLE 364 ON READER SERVICE CARD

Apple Light Pen

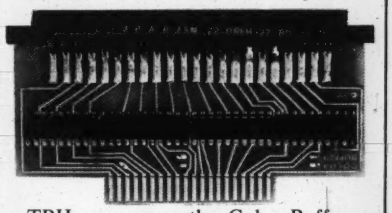
A slimline light pen for the Apple and Atari has been announced by Symtec, Inc. It provides high resolution with more than 55,000 screen locations.

The pen features a 1/2" stainless steel case, non-scratch tip, light weight telephone cord, and touch ring. It is available with a complete interface for the Apple and Atari, is supplied with full documentation and software on disk, and includes negative sync for interactive training use. $249.95.

Symtec, Inc., 15933 W. Eight Mile Rd., Detroit, MI 48235. (313)272-2950.

CIRCLE 365 ON READER SERVICE CARD

Color Buffer for Color Computer



TBH announces the Color Buffer, a peripheral for the TRS-80 Color Computer. Gaining access to the system bus through the game slot cartridge, the Color Buffer terminates in the standard 22/44 card edge connector providing the hobbyist or experimenter with easy access to fully buffered address, data and control lines. U.S., $59.95; Canada, $69.95.

TBH Canada, 67-3691 Albion Rd., Ottawa, Ontario, Canada K1T 1P2.

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So, we decided to publish a series of special magazines devoted entirely to product reviews. The first Buyer's Guide, which covered personal computers, video and electronic games, and consumer electronics products, was published in the fall of 1981, and has been very popular with regular readers as well as those new to the personal computing field.

The second in the series is our Buyer's Guide to Educational Systems and Software. In addition to evaluations of educational software, hardware, books and audio-visual material, this Guide includes practical advice on how to choose a computer or peripheral for educational use and information on the special school purchase plans offered by many manufacturers.

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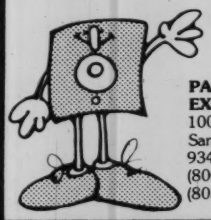

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CIRCLE 115 ON READER SERVICE CARD

computer store of the month

Rainbow Computing, Inc.
Northridge, California

Numerous computer stores carry Creative Computing products. Creative Computing would like to recognize one of these stores for their service and dedication to their customers and the computer industry. This month, we are spotlighting Rainbow Computing in Northridge, California.

The founders of Rainbow Computing have over 60 collective years of consulting experience including systems analysis and programming on all major types of mainframe computers. In the fall of 1975, after visiting a computer store, the potential for the microcomputer became obvious. Realizing it was the "wave of the future" plans were made to open a retail store in Granada Hills, a suburb of Los Angeles. Rainbow's first store, a whopping 800 square feet, was opened in April, 1976. Sales grew from one magazine a week at first, to a whole computer system three months later.

When the Apple II was introduced, with its many dynamite features, fully assembled and tested, Rainbow had to carry it. Sales of the Apple II have been phenomenal, doubling or tripling each year since the beginning. In June, 1979, the store was moved to a much larger location in the Garden Plaza Shopping Center, where it is presently located. There is a complete Apple service center and a wide selection of peripherals, software, books, and magazines, including products from Creative Computing for immediate delivery.

Rainbow Computing has a large mail-order department and warehouse which stocks the largest collection of Apple related products anywhere. In addition, Rainbow runs an educational institute which offers computer literacy courses in Basic, Assembly, and Pascal.

If you are ever in the Northridge area, stop in and see them. Their address is 19517 Business Center Drive. You can call them at 213-349-5560.

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D.E.S. Data Equipment Supply—8315 Firestone, Downey 90241. (213) 923-9361. 7 days. Commodore PET specialists. Hardware, Software, Books, Mags, Supplies, In House Maintenance.

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Atlanta Computer Mart—5091 Buford Hwy., Atlanta 30340; (404) 455-0647. 10-6 Mon.-Sat.

ILLINOIS

Computer Land/Downers Grove—136 Ogden Ave., Downers Plaza 60515; (312) 964-7762. 10-6 Mon.-Sat., 10-8 Tue., Thurs. Apple, Atari, Osborne, Xerox, Vector.

Data Domain of Schaumburg—1612 E. Algonquin Rd., Schaumburg 60195; (312) 397-8700. 12-9 Tues.-Fri., 11-5 Sat. Apple, Alpha Micro, Hewlett-Packard Calculators. Largest book and magazine selection.

Farnsworth Computer Center—1891 N. Farnsworth Ave., Aurora 60505; (312) 851-3888. 10-8 Mon.-Fri., 10-5 Sat. Apple, Hewlett-Packard series 80 systems, HP Calculators, IDS Printers.

Gavin Computers—5935 W. Addison St., Chicago 60634; (312) 286-4232. Mon.-Thurs. 9-8:30, Tues.-Sat. 9-6. Apple B & H, Atari & Commodore Systems.

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MASSACHUSETTS

Neeco—679 Highland Ave., Needham 02194; (617) 449-1760. 9-5:30 Mon.-Fri. Commodore, Apple, Superbrain, Atari.

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Steve Gray and David Ahl

The Lucifer Key by Malcolm MacPherson. E.P. Dutton, New York, NY. 338 pages, hard cover, $13.50, 1981.

A real page turner, *The Lucifer Key* is tautly written and almost believable.

The book centers around a young computer scientist, Stark Rousseau, who has developed a "formula" that could disrupt computer/satellite communications and bring to a halt nearly all the computers of the nation. Rousseau naively presents the concept of the formula at a computer science symposium and the race is on! The Russians are after it, unscrupulous industrialists are after it, and even a group of well-meaning anti-computer fanatics are after it.

The daughter of the leader of the anti-computer group is a gorgeous young model who has intelligence to match her looks. Predictably, she falls in love with the young scientist, Rousseau. Other than this somewhat implausible twist, the book is eminently believable and draws heavily upon existing programs and research in artificial intelligence, computer science, and satellite technology. Eliza, as usual, is pushed far beyond its limits and even Echo is drawn upon to write computer poetry, the likes of which have never seen the light of day. On the other hand, human characters are developed with realism and personality and respond appropriately to the computer threats as they come to light.

All in all, Malcolm MacPherson has shown that a gripping, chillingly believable adventure novel can be written with computers playing a central role. I recommend it—DHA

Graphic Software for Microcomputers, by B.J. Korites. Kern Publications, 190 Duck Hill Road, Box 1029, Duxbury, MA 02332. 188 pages, paperback $19.95. 1981.

This "self-teaching guide," as the introduction calls it, contains 61 programs for two- and three-dimensional graphics, all in Basic and all written on an Apple II Plus 48K system. A disk of the programs in the book is available for $18.95.

Like Shakespeare's comedies, this book can be enjoyed at several levels. You can just run the programs, which start with placing points and lines on the screen, move on to drawing pictures using points and lines, then show how to translate, rotate, scale and clip 2D and 3D drawings. Programs are given for shading, hidden-line removal and perspective transformations, for using tablets as input devices, and for typical graphics applications. The book ends with suggestions for practice problems for each section.

On a second level, you can read the text, if you're prepared to deal with vector math and matrices. The author says, "You can complete all of this book except the section on matric concatenation without understanding matrices."

On a third level, you might want to translate the programs for use on a non-Apple system, which of course would involve a great deal of changing the plotting commands. To make the translating easier, all the program lines consist of one statement each, and some of the more complicated lines are explained in the text.

This is probably the best book available on microcomputer graphics that can be read without a Ph.D. in mathematics, although it does require you to become fairly proficient in vector math and matrices if you want to get the most out of this undergraduate text.

TRS-80 Assembly Language by Hubert S. Howe Jr., Prentice-Hall Inc., Englewood Cliffs, NJ. 192 pages, paperback $9.95. 1981.

"Both beginners and experienced programmers have good reason to be dissatisfied with the material on assembly-language programming that has appeared thus far," according to the preface of this slim book that isn't going to satisfy all that many people either.

Although the back cover says it will give you a "clear presentation of all introductory concepts in the use of the TRS-80" and "explains assembly language programming in a thorough, yet easy-to-understand style," this isn't a book for beginners. It's much closer to being a reference book for those with some programming experience, who wouldn't feel overwhelmed by a summary, right up front on page 15, of all ten Z-80 addressing modes. Or by an Overview of the Z-80 Instruction Set on pages 18-31, a compact listing that would turn off any beginner, assuming he got that far.

After a chapter on machine language, two on the Z-80 CPU, and a short one on the stack, Howe gets right into memory mapping and using the editor/assembler. That's all you get of the Basic Concepts. Part II, Practical Programming, gets into reading and printing numbers, arrays and tables, moving data, arithmetic operations, floating-point, logical and bit operations, software multiply and divide, cassette I/O, USR subroutines, disk I/O and disk files.

This second part is pretty good, and if it explained the programs in more detail and were accompanied by a better, longer and much more detailed Part I, it might go a long way toward satisfying those people mentioned in the preface, who have yet to see a thoroughly detailed book on TRS-80 assembly language that takes a beginner from A to Z.

This book, incidentally, is typeset "using a Diablo HyType I printer with Michael Shrayer's Electric Pencil program on a TRS-80 Model I."

Program For a Puppet by Roland Perry. Pocketbooks, New York, NY. 326 pages, massmarket paperback, $2.95. 1981.

In this totally implausible story, the hero, an Australian journalist, is pitted against Lasercomp, the largest computer company in the world. Lasercomp is a thinly disguised IBM with its corporate headquarters in Westchester and a former Attorney General for its chief lawyer. It is run by the Brogans, a father-son team (harking back to the Watson days). The corporate goal is absolute power and, into their new generation of computer, the Cheetah series, the Brogans had installed a master program with a plan to elect their handpicked man to the presidency of the United States.

The journalist stumbles on the evil doing of the corporation while he is investigating the illegal sales of Lasercomp computers to communist countries. Graham, the journalist, falls in love with the proverbial beautiful Russian secret agent, finds other allies along the way, and eventually exposes the wicked scheme.

I find it curious that the Cheetah computer, although based on laser technology, uses teletypes for output. Indeed, the Brogans even have a teletype aboard their corporate jet. The story may be modern; the technology is not.

Despite favorable reviews from the *Times* and *Playboy*, I was not impressed with the book. If you must have the latest computer-related novel, by all means get it; as for me, I will wait for Robert Ludlum's or John MacDonald's next book.

—DHA

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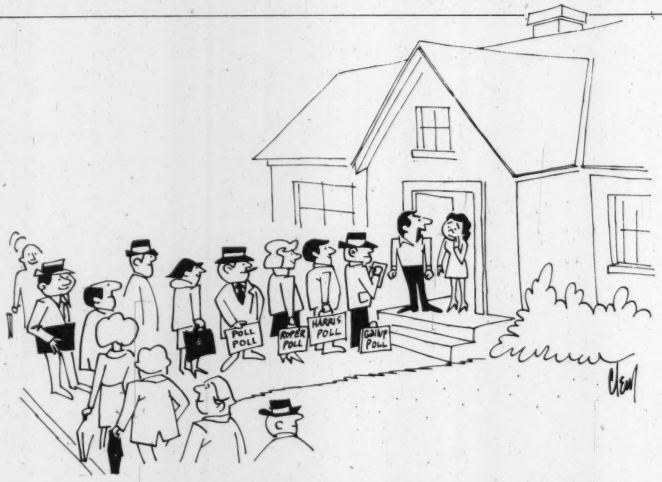

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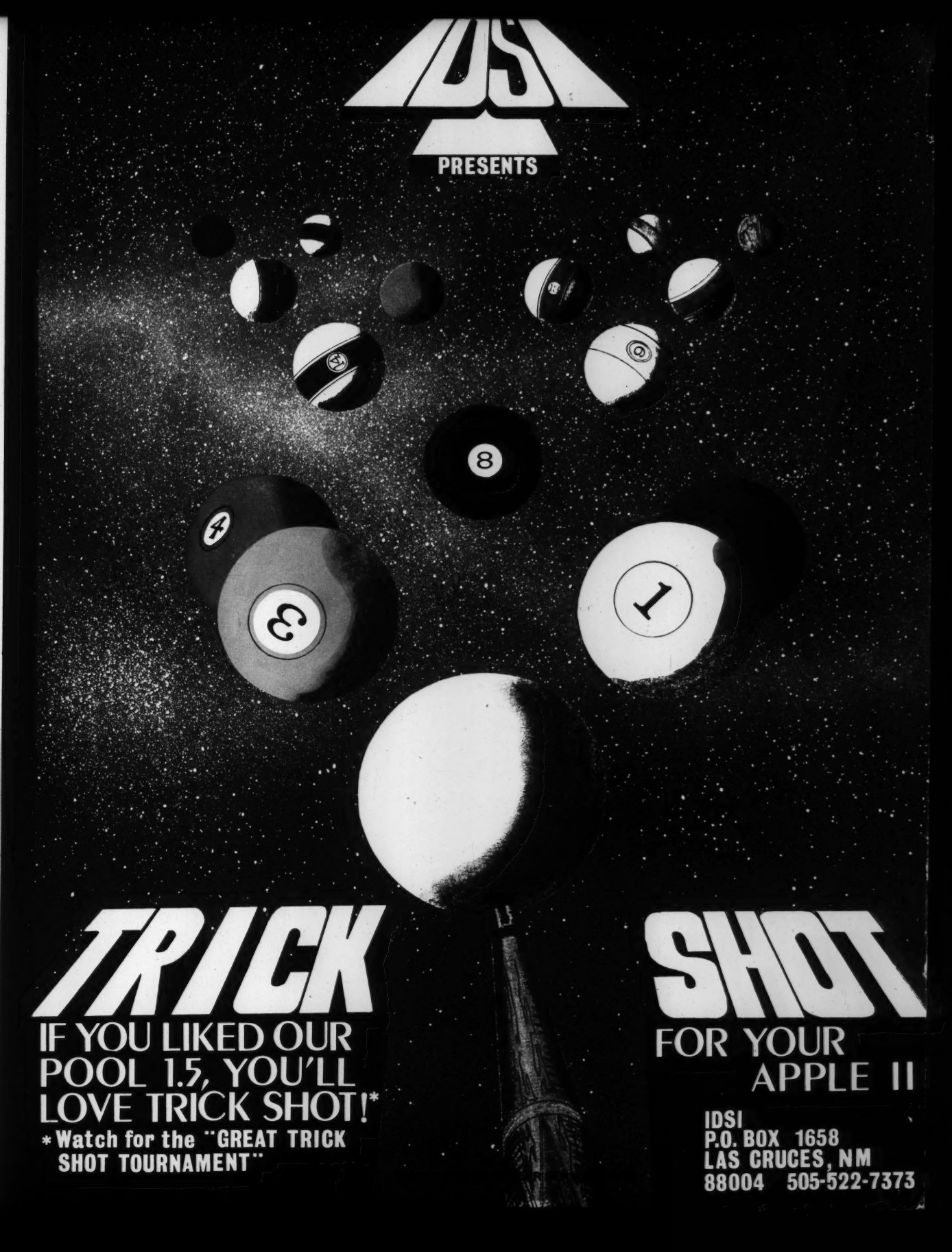
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